Amateur Radio 73

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One Lousy
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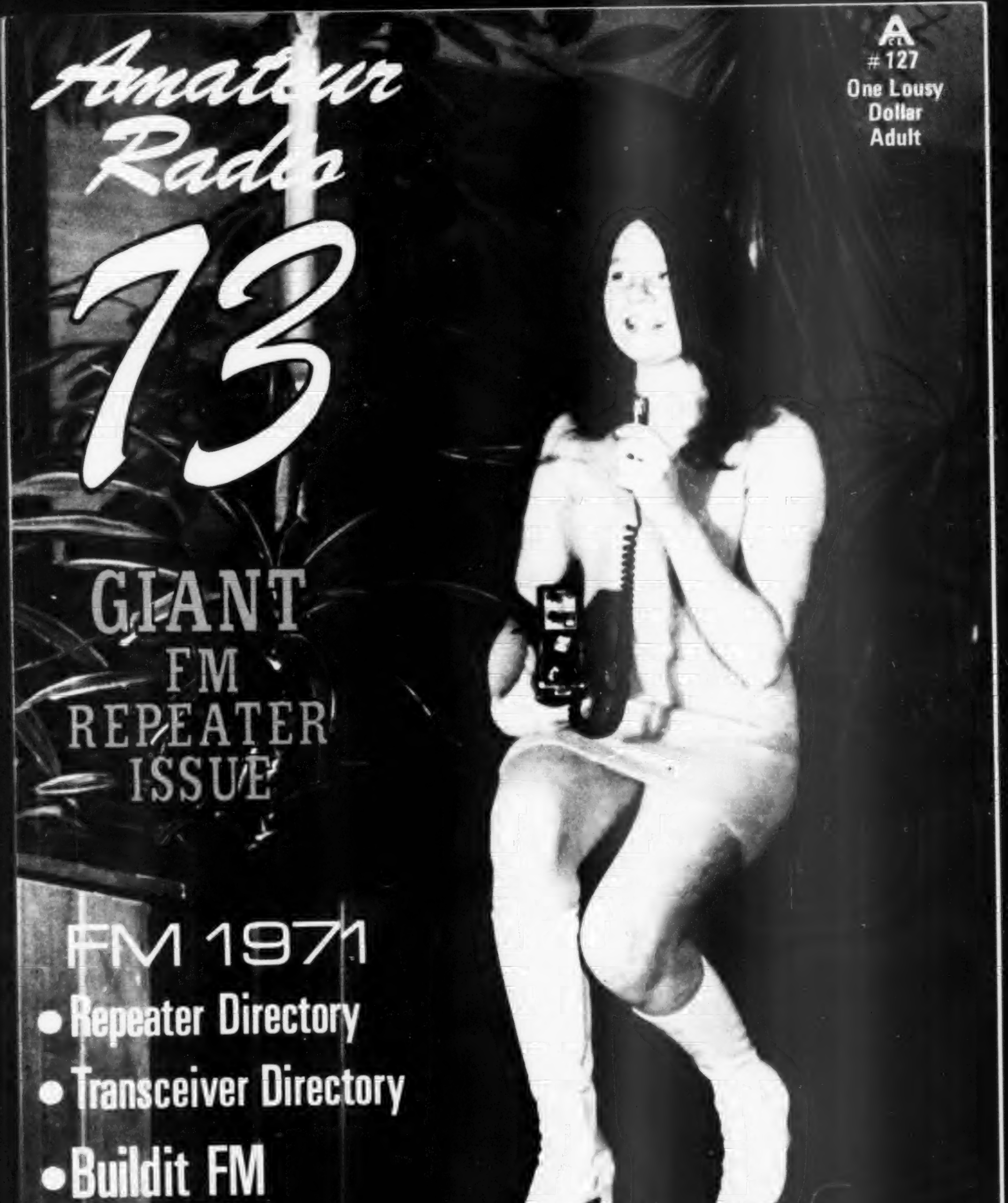
Adult



GIANT FM REPEATER ISSUE

FM 1971

- Repeater Directory
- Transceiver Directory
- Buildit FM Walkie Talkie
- Much etc.

IF YOU'VE EVER USED A REPEATER,

If you haven't
already received
a copy of our **NEW**
1971 Catalog of Precision
Quartz Crystals & Electronics
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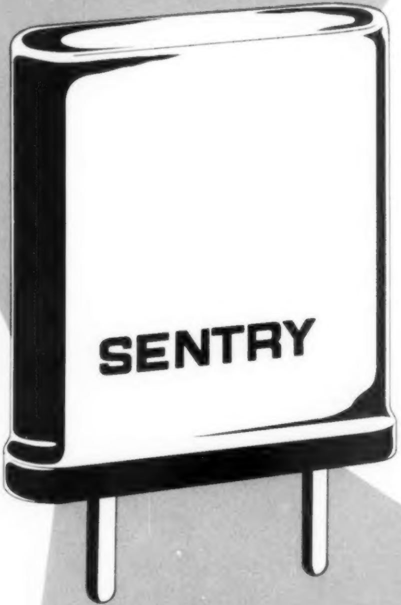

Somewhere along the line, in virtually every ham repeater in the world, you'll find a couple of Sentry crystals.

Repeater owners and FM "old-timers" don't take chances with frequency—they can't afford to. A lot of repeater users depend on a receiver to be on frequency, rock stable...in the dead of winter or the middle of July. The repeater crowd took a tip from the commercial "pros" a long time ago—and went the Sentry Route.

That's one of the reasons you can depend on your local repeater to be there (precisely there) when you're ready to use it. FM'ers use the repeater output as a frequency standard. And for accuracy, crystals by Sentry are THE standard.

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SPECIFY SENTRY CRYSTALS.

"Ask the Hams and Pros
Who Build Repeaters!"

YOU'VE USED A SENTRY CRYSTAL

SENTRY MANUFACTURING COMPANY
Crystal Park, Chickasha, Oklahoma 73018
PHONE: (405) 224-6780
TWX-910-830-6425

73 MAGAZINE

#127 April, 1971

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73 Magazine is published monthly by 73 Inc., Peterborough, New Hampshire 03458. Subscription rates are $6 for one year in North America and U.S. Zip Code areas overseas, $7 per year elsewhere. Two years $10 in U.S. and $12 overseas. Three years $14, and $16 overseas. Second class postage paid at Peterborough N.H. and at additional mailing offices. Printed at Menasha, Wisconsin 54952 U.S.A. Entire contents copyright 1971 by 73 Inc., Peterborough NH 03458. Phone: 603-924-3873. What staffers of what ham magazine have mysteriously emerged with conditional licenses? Do they even know the code? or a dB from a farad?

The Cover

Does FM run in the Sessions blood? Here is Murry Sessions, daughter of K6MVH/1 and WA6SPT/1, really enjoying the new Drake TR-22 2m FM transceiver, a six-channel portable unit which can operate from 115V ac, 12V dc or built-in batteries.

Don't miss the Dayton Hamvention – April 24th

Amateur Radio News Page

April MCMLXXI Monthly Ham News of the World Magazine

FCC TO ALLOW RTTY SPEED INCREASE

FCC Agrees to Up RTTY Speed

The Commission has under consideration two petitions for rule making submitted by Mr. Keith B. Petersen (W8SDZ) and Mr. R. Bruce Peters (WB2LRS). Mr. Petersen requests that the rules be amended to allow the use of radio teleprinter speeds of 60, 75, and 100 wpm and Mr. Peters proposes the use of 60, 67, and 100 wpm.

In support of their requests, the petitioners indicate that present commercial teleprinter standards include faster operating models as well as 60 wpm machines. In addition, it is indicated that the present maximum frequency shift of 900 Hz would not be exceeded in the use of the higher speed machines and compliance with present bandwidth limitations is possible. Further, it is pointed out that higher-speed operation will stimulate the development of new amateur skills and techniques, and will enhance the ability to handle large volumes of communications in less time. Such ability would be especially important during emergencies.

FCC is said to believe that provision for the use of additional teleprinter speeds in he amateur service, in keeping with commercial equipment standards now in use, is desirable. Since increased speeds are attainable within limits of the present bandwidth requirements, additional interference from such operation is not anticipated. In addition, since the tele-

EXTRA!

FCC Announces Proposed New Phone Bands!

Minutes before this issue went to press the FCC announced their proposal for an expansion of the lower phone bands. We will have full details next month. The deadline for filing comments on the docket is June 1, so the May issue will give you plenty of time to mull over the ramifications of the proposal.

As a starter it is proposed to cut back the four Extra class CW bands to 10 kHz apiece.

The new Extra class phone bands would start at 3.750, 7.150, 14.150, 21.200, and 28.350 MHz. The Advanced class phone bands would start at 3.775, 7.175, 14.175, 21.225, and

7075–7100 kHz. The 40m Novice band would be moved to 7.100–7.150 to make room for the new phone band. The 15m Novice band would be shortened a bit to 21.100–21.200 MHz and a new Novice band would be added on 10m to make up the difference from 28.150 to 28.250 MHz.

That's quite a bunch of changes and they will doubtless be met with mixed emotions. Since it is unlikely that anyone else will bring it up, I suppose it is up to me to mention that the proposals follow rather closely the suggestions I have made in my editorials.

THE AMSAT REPEATER

More on the AMSAT Repeater

Work is proceeding on AMSAT-OSCAR-B (A-O-B), the first of a series of long lifetime amateur communications satellites designed for launch as secondary payloads on Thor-Delta or Agena missions. A detailed specifications document on this series of spacecraft was prepared in April and distributed as guidance material for persons indicating a serious interest in developing experiments for these satellites. There are now several experiments under development.

A four-channel, hard-limiting FM repeater is being breadboarded by members of WIA Project Australis who had been involved in the construction of AO-5. The repeater is of the demodulation-remodulation type and employs a frequency of approximately 145.9 MHz for the uplink and 432.1 MHz for the downlink, with a satellite transmitter power output of 1W per channel.

A linear repeater with a bandwidth of 50 kHz is under construction by the EURO-OSCAR group in Marbach, West Germany. This repeater has an input frequency of 432.1 MHz and an output frequency of 145.9 MHz, with

power loads. They are expected to make possible satellite operating lifetimes in excess of one year.

Following designs prepared by AMSAT's A-O-B project manager, Jan King, the A-O-B internal structural assembly and experiment modules have been fabricated at the facilities of W2QJT in Ithaca, N.Y. This is actual flight hardware, and represents the beginning of construction of the A-O-B spacecraft.

An AMSAT proposal to NASA for the launch of AMSAT-OSCAR-B was submitted in August and an oral presentation was given in November. A third-party agreement has been arranged between Australia and the U.S. to permit the exchange of third-party amateur traffic concerning the satellite. This arrangement extends the previous agreement, and is set up so as to last until several months after the end of life of OSCAR 6.

FCC CHIEF

increased speeds are attainable within limits of the present bandwidth requirements, additional interference from such operation is not anticipated. In addition, since the teleprinter speed of 67 wpm is only a slight variation from the 60 wpm rate, the proposed use of 60, 75, and 100 wpm is considered to offer the most desirable variety of choices for operation

The new Extra class phone bands would start at 3.750, 7.150, 14.150, 21.200, and 28.350 MHz. The Advanced class phone bands would start at 3.775, 7.175, 14.175, 21.225, and 28.375 MHz. The General phone bands would start at 3.875, 7.225, 14.250, 21.325, and 28.500. A new phone band for DX operating only, between Region II (ours) and the other regions is proposed for

mixed emotions. Since it is unlikely that anyone else will bring it up, I suppose it is up to me to mention that the proposals follow rather closely the suggestions I have made in my editorials.

I'll try and cover the whole situation next month in depth so, depending upon your convictions, stand by for massive reassurance or deep trauma.

1W per channel.

A linear repeater with a bandwidth of 50 kHz is under construction by the EURO-OSCAR group in Marbach, West Germany. This repeater has an input frequency of 432.1 MHz and an output frequency of 145.9 MHz, with a satellite transmitter power output of 10W. The repeater is designed for use with SSB, CW, AM, FM, RTTY or SSTV, with as many stations as can fit within its 50 kHz passband.

Also being breadboarded is a linear repeater under construction by AMSAT members in the U.S. This repeater has an input frequency of 145.9 MHz and an output near 29.6 MHz, with a satellite transmitter power output of 2W. This repeater will be capable of being used with any method of modulation permitted in these two bands.

The WIA Project Australis group has developed an OSCAR telemetry encoder which transmits telemetered satellite parameters directly in 850 Hz frequency-shift keyed Teletype format, for printout on an ordinary 60 wpm teleprinter. Any station having a tape reperforator will be able to send or retransmit the received data directly to AMSAT headquarters for computer processing, or they may decode the telemetry data themselves using calibration information which will be made available prior to launch.

John Goode (W5CAY) has designed and breadboarded an OSCAR telemetry encoder which transmits satellite telemetered parameters directly as numbers in code, so that only pencil, paper, and calibration information are needed for reception and interpretation of data from the satellite.

A breadboard of a command encoder capable of providing up to 35 separate command functions has been constructed by the WIA Project Australis group. The command encoder is designed to provide a reliable and secure means of controlling the emissions of OSCAR satellites to minimize any possibility of interference.

Several panels of solar cells left over from NASA and ESSA satellite programs have been made available for use in the A-O-B series of satellites. Several of these panels are being reconfigured for use in A-O-B. Rechargeable nickel-cadmium batteries have also been made available and have been undergoing charge-discharge cycle testing under simulated satellite

HAM CUT-UP CITED BY FCC; RACISM CHARGED

The Commission, by the Chief, Safety and Special Radio Services Bureau, under delegated authority, having under consideration the suspension of the General class amateur operator license of Russell E. Jantzen, 12149 Indiana Avenue, Riverside, California, which is scheduled to expire August 8, 1973, has released an order calling for the suspension of his license.

According to FCC examiners, the licensee, while operating amateur radio station W6TBN, willfully and repeatedly transmitted communications containing obscene, profane, or indecent words, language, or meaning, in volation of Section 97.119 of the Commission's rules; and

The order also stated that the licensee used amateur radio station W6TBN for the purpose of transmitting unidentifiable noises and sound effects over extended periods of time; that such transmissions were not in plain language nor in the form of generally recognized abbreviations established by regulation or custom; that such transmissions were willfully and repeatedly made by licensee; and that such transmissions were in violation of Section 97.117 of the Commission's rules.

An interesting and perhaps precedent-setting observation was the notation that, on August 7 and 14 and September 28, 1970, licensee transmitted communications containing *language derogatory of certain races.*

According to the report, the licensee misrepresented material facts to, or concealed them from, the Commission, or was lacking in candor in his responses to official notices of violation.

It was ordered that the General class license of Russell E. Jantzen be suspended for the balance of the license term.

ASSISTANT FCC LEGAL CHIEF NAMED

The FCC announces the appointment of Vergil W. Tacy as Assistant Chief of the Legal, Advisory and Enforcement Division in the Safety and Special Radio Services Bureau. Mr. Tacy has served as a trial attorney in the Hearing Division of the Commission's Broadcast Bureau since he joined the FCC in 1961. Prior to his Government service with the FCC, he engaged in the private practice of law, and later served as a trial attorney and supervisory attorney in charge of litigation for the Securities and Exchange Commission. As special assistant to the U.S. attorney general, Mr. Tacy also engaged in the prosecution of criminal cases involving securities fruads. From 1942 to 1946, Mr. Tacy served in the Navy.

A native of the State of Iowa, Mr. Tacy received a B.A. degree from the State University of Iowa in 1935 and a Juris Doctor degree from the College of Law of that University in 1938. He is a member of the bars of the District of Columbia, Iowa, and Michigan.

Married to the former Frances Datesman, also from Iowa, Mr. Tacy and his wife reside in Chevy Chase, Maryland, and have three children.

Systemized ICs for Hams

Lithic Systems, Inc., makes its bow as the first manufacturer of communication ICs wholly committed to communication equipment. By applying LSI (large-scale integration) techniques to linear circuits, the company is developing lines of complex monolithic products to economically perform entire subsystem functions in two-way radios. Recognizing the need for direct interaction with manufacturers of airborne, mobile, handheld and other communication systems, Lithic Systems has developed a line that is a compatible group of monolithic subsystems featuring low power drain and low supply voltage capability.

The company presently uses a number of established subcontractors to perform routine production functions.

Robert A. Hirshfeld, founder and president, is formerly of National Semiconductor, where, as manager of communication circuits, he was responsible for the development and market establishment of their communication microcircuit line. An MIT graduate, he was an early participant in the development of linear integrated circuits at Motorola Semiconductor and then with Amelco Semiconductor, prior to joining National.

Facilities are established in Cupertino, California, with subcontractors in the San Francisco Bay Area and the Orient.

FCC CHIEF RETIRES

Everett G. Henry, FCC Chief of the Amateur and Citizens Division of the Safety and Special Radio Services Bureau, is retiring February 16, 1971, after more than 32 years with the Commission.

Mr. Henry was named Chief of the Amateur and Citizens Division on January 7, 1966. He had previously been Chief of the Marine Division of the Safety and Special Radio Services Bureau for six years.

In 1938, Mr. Henry joined the FCC as a field radio inspector. He was employed in private industry from 1945 to 1948, when he returned to the Commission. From 1953 to 1956 he was Engineering Assistant to former Commission Edward M. Webster. In March, 1957 he was named Assistant Chief for Engineering in the Office of Opinions and Review.

Mr. Henry is a native of Corvallis, Oregon. He received a B.S. degree from the University of Washington in 1930. Before joining the FCC he served as radio operator on passenger and cargo vessels, as chief engineer of a number of broadcast stations, and as a development engineer in a telephone laboratory.

Henry, an active amateur, does not intend to give up his call (W3BG) or to drift out of ham radio. The photo here shows Mr. Henry speaking to a gathering of FM operators at the recent SAROC funfest in Las Vegas, Nevada.

ROCKAWAY

The Spring Auction of the Rockaway Amateur Radio Club will be held Friday evening, April 23, 1970, at the American Irish Hall, Beach Channel Dr. at Beach 81st Street, Rockaway Beach, N.Y. Doors open at 6 p.m. to accept items for the sale. A $1 donation accepted at the door; refreshments included. For further info write Al Smith, WA2TAQ, Box 341, Lynbrook NY 11563.

GEORGIA QSO PARTY

Starts: 2000 GMT, Sat. May 1, 1971
Ends: 0200 GMT, Mon. May 3, 1971

The tenth annual Georgia QSO Party is sponsored by the Columbus Amateur Radio Club, Inc. There are no time or power restrictions and contacts may be made once on phone and once on CW on each band with the same station.

Exchange: QSO number, RS/RST report, and QTH (county for Georgia stations; state, province, or country for others).

Scoring: Each complete contact counts 2 points. Georgia stations multiply their total QSO points by number of different states and Canadian provinces worked. DX stations may be worked for QSO points but do not count as multipliers. Out-of-state stations will use the number of Georgia counties worked for their multiplier (a possible total of 159).

Awards: Certificates to the highest scoring station in each state, province, country, and Georgia county and also to the highest scoring Georgia and non-Georgia Novice. Second- and third-place awards will be made in sections where additional recognition is deemed to be warranted. A plaque will be presented to the highest-scoring out-of-state entry, to the Georgia club with the largest aggregate score, and to the highest-scoring Georgia portable or mobile station operating within the state outside his home county.

Frequencies: CW – 1810, 3590, 7060,

EE "HAMS" MEET AT CHICAGO

Shown are "ham" operators communicating with other radio amateurs during the recent National Electronics Conference attended by over 5000 electronic engineers and held in Chicago. The 2 kW SR-2000 base station was installed by Don De Jong (W9KUJ) (shown in foreground with mike in hand) and the radio equipment was provided by Hallicrafters. From left: Bud Drobish (W9QVA) Hallicrafters' Assistant Sales Manager; Cliff Mathews, Jr., Hallicrafters' Marketing Manager, and Rudy Napolitan, Conference's General Manager. Sitting next to Mr. De Jong representing the women "hams" is Ethel F. Marks (WA9ACO).

To promote amateur radio to the many electronic engineers in attendance at the recent National Electronics Conference in Chicago, amateur radio equipment provided by Hallicrafters, Rolling Meadows, Illinois was used. A 2 kW base station within the Conrad Hilton Hotel was installed by Don De Jong (W9KUJ), Chicago Area Radio Club Council Convention Chairman. The "hams" operated the Hallicrafters SR-2000 system consisting of the SR-2000 transceiver, the P-2000 ac power supply, the HA20 VFO DX'er unit and microphone.

WICHITA THEFT

The following equipment was stolen from the emergency communications truck belonging to the American Red Cross in Wichita, Kansas: Drake R-4B Receiver less power supply, serial #111250; Drake T-4XB transmitter less power supply, serial #16428R; Gonset "Communicator II" 2m transmitter-receiver; Gonset 2m VHF power amplifier. Anyone with information concerning this equipment is requested to contact the Wichita Police Department, 115 E. William, Wichita KS 67201.

RM-1729 Gary A. Stilwell (W6NJU)
Canoga Park, California 12-17-70

CANCER VICTIM

Late Reports from IARU Region I News

RADIO SOCIETY OF BERMUDA Rules
1971 BARC Contest

1.*Contest Period:*
PHONE: 0001 GMT May 15 to 2000 GMT May 16th 1971.
C.W.: 0001 GMT June 19th to 0200 GMT June 20th 1971.

2.*Bands*
The following amateur bands will be used: 3.5, 7, 14, 21 and 28 MHz.

3.*Exchanges*
Amateurs in the U.S., Canada and the U.K. will transmit a two figure number representing the RS report plus their State, Province, or County respectively. CW participants will transmit a three figure number representing Amateurs in the U.S., Canada and the U.K. will transmit a two figure number representing the RS report plus their state, province, or county respectively. CW participants will transmit a three figure number representing the RST report plus their state, province or county respectively. VP9 stations will give RS or RST reports plus Parish. (U.K. stations may use the official RSGB list of abbreviations for U.K. counties.) U.S. and Canadian stations may exchange reports with U.K. and VP9 stations only. U.K. stations may exchange reports with U.S., Canadian and VP9 stations only.

4.*Points*
Each contact must be complete and will count three points. No crossband or cross mode contacts permitted.

5.*Scoring*
The score for U.S., Canadian and U.K. stations will be the number of completed contacts times three points, times the total number of Bermuda Parishes worked on each band used. For example: A U.S. station having made a total of 500 contacts with U.K. and Bermuda stations and the following Bermuda Parishes: 28 MHz- 3 Parishes; 21 MHz- 6 Parishes; 14 MHz- 3 Parishes; 7 MHz- 2 Parishes; 3.5 MHz- 2 Parishes, the score would be 500 contacts times three points = 1500 points times 16 Parishes = 24,000 points final score. A U.K. station completing 500 contacts with U.S., Canadian and VP9 stations would score in exactly the same manner.

6.*VP9 Local Scoring*
Bermuda stations will receive three points for each completed contact. The VP9 multiplier will be the total number of States, Provinces and Counties worked on each band used.

7.*Equipment*
Any number of transmitters and receivers will be allowed and competitors may use the maximum power permitted under their license. However, all stations participating must be single operator only.

8.*Presentations*
Round trip air transportation for two will be provided for each winner plus one week's accommodation at one of Bermuda's leading hotels to enable the overall winners to attend the Radio Society of Bermuda's Annual Banquet to be held on October 21st to receive their awards.

9.*Awards*
A trophy will be presented to the winners of each section (U.K. and N.A.). A certificate signed by His Excellency The Governor of Bermuda will be sent to the highest scoring station in each call area as follows: U.S.A. and Canada: W1 through W0 and VE1 through VE7 including V). U.K.: G, GD, GM etc.

10.*Log Instructions*
Keep *all times in GMT* and all contestants to compute their own scores and check logs for duplication to assist the Contest Committee. Print name and call on each log. All contestants must sign a statement that the rules and regulations have been observed.

11.*Eligibility*
Contest winners, regardless of section won, are ineligible for a period of two years..

12. Should there be a tied score, the decision of the Contest Committee will be final. All logs must be received by the Contest Committee of the Radio Society of Bermuda NOT LA-

operating within the state outside his microphone. William, Wichita KS 67201. station completing 500 contacts with will be final. All logs must be received

---

home county.
Frequencies: CW – 1810, 3590, 7060, 14060, 21060, 28060 kHz. SSB – 3975, 7260, 14290, 21410, 28600 kHz. Novices,– 3718, 7175, 21110 kHz. Try 160 meters at 0300 GMT. Try 10 meters on the hour and 15 meters on the half-hour during daylight hours.

Your log should show date and time of contact in GMT, stations worked, exchanges sent and received, band used, type emission, and multipliers claimed. Checklists will be appreciated.

Include a signed declaration that all contest rules and operating regulations were observed and mail your entry to CARC, Inc., Attention: John T. Laney, K4BAI, 1905 Iris Dr., Columbus GA 31906. Entries should be postmarked no later than June 7. Please send a self-addressed, stamped envelope for a copy of the results.

FCC PETITIONS FOR RULE MAKING FILED

RM-1723 George E. Cushing (W4QVJ)
Hollywood, Florida 11-25-70
Request amendment of the Amateur Radio Service Rules to eliminate telephony between 14,200–14,225 kHz.

RM-1724 R.A. Cowan (WA2LRO)
12-7-70
Port Washington, L.I., New York
Request amendment of the Amateur Radio Service Rules to: (1) Reduce General Class operator examination code test from 13 to 10 words per minute; (2) Provide Technician Class operators telegraphy operation in Novice bands, and (3) Restore Novice telephony privileges in the 145–147 MHz band.

RM-1725 Ken W. Sessions, Jr. K6MVH
12-7-70
Peterborough, New Hampshire
Request amendment of the Amateur Radio Service Rules to drop the requirement that the station licensee continuously monitor and maintain control of a "repeater" if automatic turn-off and fail safe devices are provided and if tone access and control is provided on the repeater receive frequency

RM-1729 Gary A. Stilwell (W6NJU)
Canoga Park, California 12-17-70
Request amendment of the Amateur Service Rules to provide expansion of the 3.8, 7.2, 14.2 and 21.25 MHz telephony bands "to more equally distribute frequency allocations between the Extra, Advanced and General class of operator licenses."

ALBERTA

The radio clubs of Southern Alberta are hosting the combined 37th Annual Waterton-Glacier International Hamfest – Alberta Hamfest at the beautiful Waterton Lakes National Park, July 17–18, 1971.

ROCK RIVER

The fifth Rock River Hamvention will be presented by the Rock River Radio Club of Dixon, IL on May 16 from 9:00 a.m. to 5:00 p.m. at the Lee County 4H Center, Amboy, IL, which is located one-half mile east of the intersection of Highway 52 and 30. Concrete-floor buildings are under contract this year, so no dust problem. Advanced tickets $1.50, at the door $2.00. Plenty of parking and food. Plenty of tables, all under roof. Campers welcome. Talk-in frequency is 3.950 and 50.4 MHz. *(Ed. Note: No 146.94 FM?)* For tickets send check or money order to Carl Karlson, W9ECF, Nachusa, IL 61057.

SYRACUSE FEST

On April 17, 1971, the RAGS hamfest will be held at Song Mountain off Exit 14 of Interstate 81 south of Syracuse, New York. This get-together serves the Northern, Central New York and Southern Tier amateurs well, and serves to promote all phases in the hobby of amateur radio.

The hamfest planners have been organizing for a long time to assure the success of this. If you can make it, DO make it!

CANCER VICTIM AIDED BY HAMS

On September 21 Marshall Jones, WA2MID answered YU1BCD in Pancevo, Yugoslavia. YU1BCD needed help. A five-year-old girl who had just been operated on for cancer was in desperate need of a new drug that was available only from U.S. sources. Marshall called Dave Marks (W2APF) who has had a great deal of experience in assisting in other similar situations. Uncle Dave started things going. The first shipment was lost, but finally the drug was delivered. The happy ending of this story is that the little girl is doing very well, and will soon be walking again, thanks to Marshall, Uncle Dave, and a great many others who helped.

1971 AMATEUR ALLOCATIONS

Technician

CW & PHONE: 50.1–54.0, 145–147, 220–225, 430–450, 1250–1300, and up.

GENERAL

CW: 1800–2000, 3525–3800, 3900–4000, 7025–7200, 7250–7300, 14.025–14.200, 14.275–14.350, 21.025–21.250, 21.350–21.450, 28.0–29.7, 50.1–54.0, 144–148, 220–225, and up.*
PHONE: 1800–2000, 3900–4000, 7250–7300, 14.275–14.350, 21.350–21.450, 28.5–29.7, t0.1–54.0, 144.1–148, 220–225, and up.*

ADVANCED

CW: 1800–2000, 3525–4000, 7025–7300, 14.025–14.350, 21.025–21.250, 21.275–21.450, 28.0–20.7, 50.1–54.0,' 144–148, 220–225, and up.*
PHONE: 1800–2000, 3825–4000, 7200–7300, 14.200–14.350, 21.275–21.450, 28.5–29.7, 50.1–54.0, 144.1–148, 220–225, and up.*

EXTRA

CW: 1800–2000, 3500–4000, 7000–7300, 14.000–14.350, 21.000–21.450, 28.0–29.7, 50.0–54.0, 144–148, 220–225, and up.*
PHONE: 1800–2000, 3800–4000, 7200–7300, 14.200–14.350, 21.250–21.450, 28.5–29.7, 50.1–54.0, 144.1–148.*

Late Reports from IARU Region I News

GENEVA

The IARC convention took place during the latter part of 1970. The technical sessions were held in the ITU council chamber. Representatives of the following national societies were present: ARI, ARRL, DARC, Radio Club of the German Democratic Republic, Radio Amateurs Libanais, PZK, REF, RSGB, SRJ and USKA.

The convention was opened on the Friday evening by R. E. Butler, Deputy Secretary-General of the ITU. A reception was held at which a number of delegates from an IFRB seminar were present.

The technical sessions were held under the chairmanship of G2BVN and the following speakers were heard: F3FA, DL1XJ, DL1FL, DM2HGO, I1BAY, SP5HS, YS1AG and YU3BH. In addition, a paper from ZL2AZ was read by HB9AJU and there were two showings of the ARRL film "The Ham's Wide World."

50 MHz BEACON STATION

Canadian station VE8YT, located at Clyde River (on the north coast of Baffin Island, some 1700 miles north of Ottawa), went into full-time operation on October 4. This beacon operates on 50.098 MHz with an output power of 65W into an omnidirectional antenna.

Reception reports are requested; these should be sent to Larry Kayser, 59 Westfield Crescent, Ottawa 5, Canada.

The beacon has been heard on two occasions by TF3EA and is expected to be heard in Europe during unusual propagation conditions.

by the Contest Committee of the Radio Society of Bermuda NOT LATER THAN July 31st 1971.

The following abbreviations of Parishes will be used on CW.

SANDYS	SAN
PEMBROKE	PEM
SOUTHAMPTON	SOU
HAMILTON	HAM
ST' GEORGE	GEO
DEVONSHIRE	DEV
WARWICK	WAR
SMITHS	SMI
PAGET	PAG

Further information can be had by writing the Radio Society of Bermuda, P.O. Box 275 Hamilton, or by writing the Contest Chairman, P.O. Box 73, Devonshire, Bermuda.

Ham Radio Mag Noses Into 3rd Place

Congratulations are, it is reported, in order to Ham Radio magazine for their recent passing of CQ in the circulation battle. Ham Radio has been doing well with its completely noncontroversial editorial policy and its fare of construction projects aimed at the engineering level amateur. Is it a sign of the times to find so many amateurs becoming interested in the serious technical aspects of amateur radio, apparently losing interest in the operating news, contest reports, and columns which have been the mainstay of CQ magazine?

TELL OUR
ADVERTISERS
THAT YOU SAW IT
IN 73
EVEN IF
YOU DIDN'T !!

NEVER SAY DIE

. . . de W2NSD/1

EDITORIAL BY WAYNE GREEN

THE INSTITUTE?

The recent editorial going into some of my proposals for improving the League brought considerable favorable mail, including quite a number of requests that I reconsider starting the Institute of Amateur Radio again.

There are undoubtedly quite a number of readers who are a bit hazy on how the Institute started, how it fared, what it did, and what happened to it. Did it really take in tens of thousands of dollars that I absconded with? Was it really the threat to the League that some HQ people thought it was? Did the Institute really help amateurs in legal difficulties with grants of money? Did the Institute really register as a lobby with congress? The Institute first started back in 1962 when it was incorporated in New Hampshire as a nonprofit membership corporation. The original purpose of the Institute was to promote amateur radio and provide a working club for amateurs who were interested in group travel. The Institute was promoted in 1963 primarily as a means for group traveling to foreign countries and this culminated in October 1963 when the Institute ran a guided tour to Europe for 73 amateurs and their families.

The tour was a resounding success. We went to London, Paris, Geneva, Rome, and Berlin. We met with the local amateurs in these cities, got together for dinners, parties, and other events with them. We even organized an audience with the Pope while in Rome!

With the submission of the petition for punishment licensing by the

In order to prove that all monies coming in were being strictly accounted for we published the list of the Institute members in 73. Thus anyone could easily calculate the Institute income. Also, if any amateur sent in money and found himself not listed he could take us to task for trying to hide income. We felt that this was reasonably foolproof as protection for the membership.

Since our primary purpose was to lay the foundation for a lobby in Washington one of our first moves was to subscribe to a press clipping service so we would get copies of all newspaper and magazine articles touching on amateur radio. With this valuable material we put together newsletters which were sent to all senators and representatives in Washington as well as all state governors.

As these newsletters continued to extol the virtues of amateur radio and point to specific instances of amateurs saving lives, getting the medicine through, and helping in all sorts of emergencies, the response from the congressmen began to escalate. We offered them form letters to help them with their problems with constituents pressuring them on CB and ham matters . . . and these forms were requested in satisfying quantities. We made sure that they understood the difference between amateur radio and CB, a distinction that is fuzzy or nonexistent with much of the general public.

A well known and respected amateur in Washington volunteered to help as the contact man for a Washington lobby. He was registered

Dave and 73 were no match for the organization against them and eventually the money ran out. Dave gave many times over the few thousand dollars he earned from the Institute with his time and devotion to it. An accounting was made to the members of all the funds received by the Institute, with 73 making up the deficit at the end.

The Institute has not been permitted to die entirely. I still file with congress as a lobby for amateur radio and, when I can, I personally go to Washington and see as many people as I can in the limited time I have available. We have been reprinting the more interesting news pages from 73 and sending them to congressmen. Much more can and should be done, but we are running 73 with a skeleton crew and this means more work for everyone than they can handle. Even so, we are just skinning through the present depression, trying to put out the biggest magazine we can, but still making sure that we stay in business.

How many amateurs supported the Institute? Certainly there must have been a few thousand that sent in their money for so valuable a program. In fact, the total number of founding members numbered about 600. The total income received from these members was $6030.

Did this six thou find its way to my pocket? What happened to this grand sum? Well, $500 was spent on the legal defense of W0JRQ's tower case. Note that the ARRL has yet to ante up one single dollar for an amateur fighting a legal case which could affect all of us. The case came out successfully and we had a nice letter from W0JRQ thanking the Institute for helping him over a very rough spot. Loss of the case could have been catastrophic for amateur radio.

The clipping service and the newsletter to congress accounted for about $2000 of the funds. Another $900 went for membership certificates, membership cards, (and they were spectacular laminated cards), stationery, envelopes, stickers, buttons, etc.

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the FM scene

by K6MVH

FM is where it's happening right now. Have you had the chance to look over the repeater directory in this issue, and possibly compare it with the directory published in 73 one year ago? If so, you will have noticed that with*in* that one-year period, the actual number of operating repeaters in the U.S. and Canada has doubled! But another interesting fact is that the average number of users per repeater has also increased substantially this past year, with the result that there are nearly three times as many people using FM today (as compared with estimates for one year ago).

A year ago there were two companies in the FM transceiver business: Varitronics and Galaxy. Today there are twelve, and more coming. And today there is a peripheral industry supported by the FM crowd – people who make code identifiers for repeaters, special antennas, rf power amplifiers, tone encoders and decoders, schematics. Then there are the commercial FM surplus dealers, specializing in the "amateurization" of such well known breeds as Motorola, RCA, GE, and Aerotron.

From outward appearances, it would seem that FM and repeaters are shaping the future and destiny of amateur radio's highest popular frequencies – this is something for which we can all be grateful, because growth means activity and activity means growth. And a growing, active band won't be snatched up because of nonuse. Now, for the first time in more years than is comfortable for any of us to remember, ham radio is on the upswing. *Isn't that groovy ?*

Paris . . . what can I say? The Lido

International FM

Repeaters aren't strictly an American phenomenon. Reports keep coming in about interesting repeater developments in Europe. The DL0STA machine, for example, in Stuttgart, is reported to give excellent coverage over a very wide area from its unique location atop the famous needle tower there.

If all goes according to plan, Wayne and I will get the chance to visit some of the European repeaters next month. I want to talk with the representatives of the major FM clubs to learn what they're doing in the way of standardization of tones, frequencies, control methods, etc. If possible, I'd like to offer assistance and lend publicity to their efforts, so that they can avoid some of the problems our own early efforts encountered. It would be beneficial also to maintain some degree of compatibility between European and American systems, so as to allow a maximum interchange of ideas.

If the trip goes off as scheduled, I should be able to return with plenty of color slides to share with American radio clubs. And the next repeater directory that 73 publishes will be able to reflect the FM action taking place all over the world. With this European visit, I will try to set up a line of communications with the European repeater principals so that we in America can keep abreast of the growth of repeaters in those western countries.

Something For Free

As a promotional giveaway for SAROC, Wayne printed a flock of miniature bumper stickers for FM'ers. The bumper stickers bear the words, "Listening 94," "Listening 82," together for dinners, parties, and other events with them. We even organized an audience with the Pope while in Rome!

With the submission of the petition for punishment licensing by the ARRL in late 1963 I found that the pressure was really on from 73 readers for the Institute to become more than just a travel club. The membership fee had been set at $1, which just about covered the cost of a membership card and certificate, leaving little for any other work and none at all for salaries. If the Institute was to be of any value to amateur radio I felt that it must fulfill some of the functions that the ARRL refused to accept as responsibilities such as a Washington lobby, financial help to amateurs fighting legal suits which could affect amateur radio seriously, public relations for amateur radio, etc.

This was a big bite and would need more income than seemed reasonable to expect if it were to be effective. After discussing this with quite a number of influential amateurs, individually, as well as at clubs and conventions, I decided that it was worth making a try. But would the amateurs support a new club? Complacency and apathy were running deep and I realized that I was gambling that there were enough amateurs seriously interested in the future of the hobby to support what I had in mind.

We decided to set the yearly membership fee at $10. This was high compared to the ARRL, but then the Institute was intended to provide a lot more for the amateur than the ARRL had to offer. Compared to national clubs in other fields the $10 was small. We felt that the propsect of a Washington lobby, legal help, P.R., and other programs would be of far more value than the League's offering of a code practice station, bulletins, and an almost phantom organization. And besides, we did have the makings of our own "W1AW" for code practice and bulletins, if that was wanted by the membership.

The response to the $10 membership was not encouraging. Several hundred amateurs supported the program.

nonexistent with much of the general public.

A well known and respected amateur in Washington volunteered to help as the contact man for a Washington lobby. He was registered by the Institute with congress, as required by law, as an official lobbyist for amateur radio . . . the *first* man ever to be so registered!

Though the response to our pleas for membership were disappointing, there was enough money to send out the newsletter to congress as long as no salaries were paid. I set the type for these, laid them out, pasted them up, made the negatives, stripped them into flats for making plates, made the plates, ran them through our small offset press, folded them, addressed the envelopes, and mailed them. It was one hell of a lot of work, but I didn't know any other way to get it done.

Then the attack began. Letters began arriving from amateurs saying that ARRL directors had been to their clubs and ridiculed the Institute. WARN, an underground bulletin allegedly financed by the League, was sent regularly to every amateur listed in 73 as a member of the Institute. WARN ridiculed anyone stupid enough to support the Institute, suggested improprieties and went on at unbelievable length repeating the ARRL line that only one national organization was needed and that anything else was bad for amateur radio. WARN was sent to just about every amateur club in the Country affiliated with the League.

The attack was successful. The trickle of memberships dwindled to a dribble. This unfortunately coincided with a long period of sickness on my part when I was totally unable to work. The Institute directors worked hard to find someone to replace me as acting secretary of the Institute, finally selecting a well known and active amateur, Dave Middelton (W7ZC), an ex-ARRL director! Dave, with the help of his wife, working for a small salary to keep the Institute going, worked hard to overcome the campaign against the Institute, keeping information going to congress.

letter to congress accounted for about $2000 of the funds. Another $900 went for membership certificates, membership cards, (and they were spectacular laminated cards), stationery, envelopes, stickers, buttons, etc. With the exception of the purchase of some used equipment for Dave (typewriter, file, Ditto machine, photocopier, etc.) most the remainder went for the secretarial expenses at W7ZC.

Over a period of about three years the Institute did rather well with the little money available. The ARRL spends over double that every month on nonpublication expenses . . . to what advantage? The Institute did help to win an important tower case . . . it did keep a representative in Washington . . . it did send frequent mailings to congress. On the negative side, it probably caused the League to spend up to $20,000 of the membership money in fighting the Institute.

Since the League is able to defeat any new organization that comes along by spending whatever is needed to stop it, there seems little use in trying to go that route. The Institute was organized explicitly to augment the League by performing functions that the League had no intention of performing . . . and still it was effectively killed off. Any threat, no matter how remote, must be stopped.

NEW EUROPEAN HAM TOUR IN OCTOBER

Many of the amateurs that went on the 1963 tour of Europe have asked that we again organize a trip. We came close a couple of years ago, but emergencies put a halt to our plans. We are again thinking in terms of a possible trip this fall to Europe . . . and perhaps one next spring.

The tour would start in early October and is tentatively scheduled to stop at Paris, Munich, Zurich, and Amsterdam. October was chosen for several reasons . . . Europe is still warm at that time of year but not hot . . . not too rainy . . . the summer crush is over . . . off-season airline and hotel rates save considerable money.

We are planning on a get-together with amateurs in each of these cities so we can get to know them.

use. Now, for the first time in more years than is comfortable for any of us to remember, ham radio is on the upswing. *Isn't that groovy?*

Paris . . . what can I say? The Lido . . . the flea market . . . the left bank . . . the Eiffel Tower . . . The Champs-Elysées . . . the dress boutiques for the wives . . . and the great friendship of the French amateurs. Munich! Remember that the Munich Octoberfest is world renowned . . . a three-week-long party with new wine, and incredible amounts of beer. Add to that a visit to the Nymphenburg Palace . . . and other great sightseeing spectacles. Zurich . . . inexpensive watches . . . your own numbered Swiss bank account . . . tiny back streets with fascinating stores . . . toy shops . . . woodcarving . . . and a gourmet paradise of fondue bourguignonne and other specials. Amsterdam . . . the city of canals . . . more than Venice! Great food . . . Rembrandt's home . . . Anne Frank's house . . . inexpensive jewelry . . . and chocolate!

Our tour will be limited to 73 amateurs (including their wives). The cost of the tour, including jet to Europe, flights between all cities, all hotel accommodations, breakfasts, and transportation to and from the airports probably will run on the order of $800 per person for a three-week trip. We are going to have a wonderful time . . . how about joining us? A $200 deposit per person will hold a reservation for you. You may cancel at any time with a full refund up until August first and with a 75% refund up until September first. But remember, we can only handle 73 people; so it has to be first-come, first-served.

Lunches and dinners are not included on the assumption that most people will want to have their hotels and such taken care of but will want to be free other than that so they can go sightseeing, visit local amateurs, experiment with interesting restaurants, and such. I have a good deal of experience in these cities, and will be on hand all along the line to advise and make suggestions as to what to see and do.

The hotels will be good, but not those darned imitation American hotels which take all the European flavor out of travel.

Best of all, we will all be amateurs and traveling together . . . and that is what makes the real fun. How about it?

countries.

Something For Free

As a promotional giveaway for SAROC, Wayne printed a flock of miniature bumper stickers for FM'ers. The bumper stickers bear the words, "Listening .94," "Listening .82," "Listening .76," etc. He printed a lot of these things and we have plenty of them left over. For a limited time, 73 will be making them available to anyone interested at no cost. Just send a self-addressed stamped envelope to 73, Peterborough NH 03458, saying what frequency you want to advertise. These have been printed up for all standard FM channels, but the supply is limited, so we can offer only two to a customer. Don't forget to specify frequency, because we're not mind readers. Also, please understand that these are on a first-come, first-served basis; we probably won't reprint them when we run out. We have stickers for .70, .73, .76, .82, .85, .88, .91, and .94. If you want more than two stickers for any one frequency, don't ask. Wayne thinks we'll get maybe three or four hundred orders. I think we'll get a couple of thousand. Let's show him, shall we? Send in those SASEs now, before you forget.

Repeater
Proposal
RM-1725
TURNS
ME
ON

WTW ROUNDUP

David Mann K2AGZ

The WTW program has not kept current for a very long time, neither from the standpoint of sufficient coverage in these pages, nor on the part of those hams who formerly showed interest in it. Above all, WTW has suffered from neglect on the part of the WTW editor, namely myself. There are many reasons for the situation, and while it might be of some value to examine them, there would be little point to it, unless for the purpose of avoiding the same problems in the future.

One thing is abundantly clear: unless immediate steps are taken to remedy the ailment, the patient is in danger of succumbing. For that reason we are going to take a gander at it, make some significant changes, and see if we can't pump some life into the old bones.

A number of participants have complained about the overly large certificate, and have suggested that it be reduced to the same dimensions as the DXCC award. This shall be done as soon as the printer can produce them. Also, all prior certificates will be replaced with new ones at my expense. These will incorporate updated scores. Together with the new certificates, each recipient will receive a set of report forms, to be filled in and filed on a quarterly basis, so as to bring all scores up to date for inclusion in the WTW rolls, which will be printed in the magazine four times yearly.

There will no longer be separate certificates issued for 100, 200, and 300 or more countries, but endorsement stickers instead. After the basic 100 country award is issued, all subsequent totals will be covered in 20-country increments, to be attached to the certificate by the holder himself. These endorsements shall be issued upon receipt of the aforementioned quarterly reports. Only submissions made in this prescribed man-

Of course, it goes without saying that any accounts of such DX operations will also be welcome. We would like to include them, for they help to encourage others to operate similarly. In line with this, we are also interested in hearing whatever items you might manage to pick up in your on-the-air contacts with stations planning unusual or off-the-beaten track DX operations.

Please bear in mind, the success of a DX feature depends in large measure upon the cooperation and participation of contributors, for without them it becomes a one-man show, lacking in sufficient breadth and scope. I will rely upon your interest and willingness to pitch in with whatever items you can send in.

Hopefully, we can make up all the lost ground in the WTW program and get it going again. I can assure you that if sincerity of purpose and energy count for anything, WTW will be a healthy and vital program . . . one in which you will be happy to participate.

After the long, long wait for Laccadives to appear, it finally showed up over the long path on 20 meters. The boys were transmitting below our band and listening between 14.270–.300. I had a miserable case of laryngitis, but spent two days at it, and finally got a contact. I believe the operator at the time was Venkat, signing VU5KV. Signals were not of the best quality. As usual, the long-haul stuff showed up at around dawn, here on the East Coast, and the band dropped out after a couple of hours. At his best, he was about 5/7 here, although from some folks' reports, the signals were much better than I could copy. Or was it just a case of gilding the lily just a trifle?

The annoying thing about an operation like this one, where the DX station sits outside our band and

mail, strictly on the up and up. You just never can tell!

The following stations appeared on the last published WTW list, several months ago. They are, by no means, the only certificate holders . . . several of them have updated their scores, and have won awards on different bands. Although the list as it appears here is not fully accurate, it is as good a starting place as any to pick up the award program where it left off. It is hoped that by the time the next list is published, it will be up to date as to scores, and those stations which are omitted inadvertently will be included.

7 MHz CW 100
W4BYB
W3WJD
W8ZCK
VE3BLU
W5AB

14 MHz CW 100
WB6NWW
K4CEB
W8EVZ
W4CRW
WA2DIG
K8IKB
WB6SHL
W9HFB
W5ODJ
WB2TKO
WA9KQS
W1ETV
K5BXG
K4ASU
WA6GLD
W2UGM
WA2LRK
K4TSJ

14 MHz Phone 200
W4NJF
W3DJZ
K3YGJ
K6CAZ
W3AZD
XE2YP
WA2SFP
WA5LOB
WB2WOU
W1MMV
K8YBU

CN8FC
WA0OAI
W0SFU
W4HA
ZL3MN
W3NKM
W8WAH
VE3ELA
WA4WTG
W6MEM
WA2EOQ
WB6RMZ
K5BXG
WA4OPW
W8BVF
W6OHU
W8FPM
K2QOU
VK3XO
VE6AKV
K5TGJ
K4VKW
SV0WL
W3SEJ
WB2NSG
K4GXO
3C5QK(VE5)
W8ROC
W1EED
FR7ZG
OE2EGL
W1PCCD

21 MHz CW 100
VE6TP
WB2UDF
WA6GLD
W0RRS

As you can readily see, I have made no effort to list these stations by the number of credits, since we intend to bring all scores up to date in time for inclusion in the complete list which will appear in a couple of months. Also, those stations who were previously listed for WTW-100, and who subsequently achieved WTW-200 have received dual listing. In future, any station which upgrades into a higher category will automatically be deleted from the first list.

As stated before, all lists will be examined for countries worked in 1966. These must be worked again, if credit for them is to be maintained. If the country no longer exists, it will simply be credited to your overall total (1st figure) and another country must be worked to bring the current figure (2nd) up to snuff.

Drawings for the new certificate are on the board and will be sent to the printer shortly. They will be sent out as soon as possible. Please be patient, and bear with us, and *please* don't send in any inquiries, corrections, or updated scores until I give word that we are ready to handle them. Okay?

73/Gud DX de K2AGZ■

Caveat Emptor?

MANUALS – $6.50 each: R-390/URR, R-390A/URR, USM-24C, BC-639A, SP-600JX, BC-348JNQ, URM-25D, TS-497B/URR, ARR-7, OS-8C/U, CV-591A/URR, BC-779B, TS-186D/UP, FR-5/U. S. Consalvo, 49055 Roanne Drive, Washington DC 20021.

VIRGINIA STATE ARRL CONVENTION. May 22-23, War Memorial Building, Vinton, Va. Rt. 24 (Off 460 – in Roanoke County. Saturday 6 PM Registration & Social. 8:30 PM Firstnighter Round & Square Dance. Figures by Andy Anderson – Music by the Top Notches. Free Western Square Dance Demonstration. Casual

"I LOVE THE BANJO" my latest Stereo LP 36 tunes Dixie to Classics banjo solo $4.95 PP. Richelieu, The Banjo Man, W9JS, 215 S. Washington, Wheaton IL 60187.

TRANSISTOR CHECKERS. . .Portable, check surplus specials fast. Simple plug in test tells NPN PNP good nogood. . .$5 postpaid. W6PJN, Box 611, Clovis CA 93727.

SALE – 75A4 $325, C.E. 100V new 2AP1 scope tube excellent condition $300. FOB Burt Weidenhamer K4DVT, 3761 18th Ave, N., St. Petersburg FL 33713.

GET YOUR "FIRST!" Memorize, study – "1970 Test-Answers" for FCC First Class License, plus "Self-Study Ability Test." Proven. $5.00. Command, Box 26348-S, San Francisco CA 94126.

MOTOROLA PT-300 5-WATT WALKIE TALKIE. Two icad batteries, charger. .34–.76; .34–.94; .94–.94; .34–.76, .94; .94–.76, .94. Excellent condition $300. Robert Gold W9GBD/8, 6731 Rushton, Dayton OH 45431.

HEATH TX-1 $120; HW-32 w/100 kc cal. & mike $109, HP-13 $50, HP-23 $40, Heli-whip ant. $20, ALL 4 items $205, EXCELLENT CONDITION; Lincoln 6 Meter Tx-Rcvr $15; HQ 170C w/clock $100 or best offer, Electronically FB; Novice rig 40/80 xmtr CW-AM 25 watt $25. FOB Tom Gundlach WB4NPU, 1535 Monte Carlo Court, Merritt Island FL 32952.

SELL OR TRADE, HT 40 transmitter SX71 Rcvr. 2K. PEP Linear. Interested in 2 meter FM gear, no junk. E. DeCobert, 609 Henrietta St., Gillespie IL 62033.

HIGH VOLTAGE DIODE STACKS + surge capacitors. Long=48, short =32–1500 PIV diodes. Get 300/600/1200 ma. Insulated Mounting. Long $6, short $5. Quantity discount. WA5UNL, 5429 46th, Lubbock TX 79414.

HOBBYISTS – Electronic components at huge savings. Transistors, 2N3566 and 2N3567, 6 for 25¢, 2N3638, 4 for 25¢, capacitors 10¢,

to the certificate by the holder himself. These endorsements shall be issued upon receipt of the aforementioned quarterly reports. Only submissions made in this prescribed manner will be considered for endorsements or listing in the quarterly WTW standings.

Apart from these changes, there is one other. Two new categories will be established as a permanent, ongoing part of the program. WTWM, consisting of contacts with DX mobile stations, and MWTW, consisting of DX contacts from your mobile. In all other respects, the same rules apply . . . one band, one mode.

We are now approaching a point when the five-year limitation on country longevity is being implemented. You will recall that one of the regulations in the program calls for the deletion of those countries worked prior to five years previously. They have to be worked again in order to qualify. Of course, this means that those countries which no longer exist will simply be dropped from the total score. We plan, therefore, to establish a listing similar to DXCC, in which two figures are given, the first one being the total countries worked including deletions, and the second one being the current score, counting only valid credits.

As to additional DX activity in the pages of 73, we are going to institute a regular DX feature, consisting of appropriate DX items, QSL information, advance notice of DXpeditions, etc. We solicit items of DX interest from the readership, so that we may be as efficient as possible in covering the full picture. And, speaking of pictures, we also solicit as much illustrative material as possible. If you operate from a vacation DX QTH, using a reciprocal license, or from the shack of a resident ham's location, make sure that you can get some good quality snapshots of the action, so that we can include it in our monthly column. If you can manage to include some local color (preferably in bikinis) so much the better. Who wants to look at pictures of yagis and quads, anyhow?

copy. Or was it just a case of gilding the lily just a trifle?

The annoying thing about an operation like this one, where the DX station sits outside our band and listens up above, is the growth of a mob of self-appointed monitors, riding herd on the DX transmit frequency. This can be pretty unnerving. After all, in these days of transceivers, it is very easy, in the heat of the chase, to forget to use the external vfo and wind up calling on the wrong QRG. The moment this happens, at least two dozen guys, all with kilowatts, chime in to tell the guy he's out of the band. In some cases they tell him a lot more than that, too. The resultant din is much worse than the small amount of QRM caused by the fellow who forgot. But I suppose it gives some guys with big mouths something to think about while they talk! Most of the time, the stations which get on the wrong spot by mistake rectify it promptly, but there were a couple of times when I heard them continue calling for ten minutes after having been told to QSY up the band. I guess some guys are just stubborn.

Well, anyway, it felt good to polish off this one, especially after it had been scrubbed a few years ago with those other four rare ones.

We keep hearing persistent rumors about three of the most wanted countries, Bouvet, Clipperton, and South Sandwich. To the best of my ability to track these down, they remain just rumors. There is no evidence to suggest anything more than wishful thinking and a vivid imagination. Some guys suffer from a pathetic willingness to substitute idle chitchat for cold, hard facts.

If and when these or other items materialize, you will be advised of it here. Meanwhile, if you happen to hear anything from a guy claiming to be on one of these rare spots, work him first and ask questions later. I have had a number of experiences like this, when everybody called the stations phonies and pirates, and then subsequently a QSL showed up in the

WA2SFP
WA5LOB
WB2WOU
W1MMV
K8YBU
PY3BXW
W6MEM
WB2NYM

14 MHz Phone 100
W4NJF
W5KUC
W3DJZ
W4CCB
W2PV (WA2SFP)
K6CAZ
W0NGF
W3MAC
K1SHN
K8IKB
W6YMV
W1SEB
WA5LOB
W4TRG
WB2NYM
KP4RK
W1MMV
WA9KQs
WA4WIP
W4FPW
K9OTB
W4JVU
WA4RMX/DL5HH
W4FPS
K3YGJ
VE6AKP
K2BQO
W3AZD
WA5DAJ
OZ3SK
ZL3OY
K4RZK
W4OPM
W2PV (WA2SFP)

28 MHz Phone 100
W2PV (WA2SFP)
W4GJO
W5YPX
WA5LOB
W2VBJ
WA5DAJ
W6MEM
WB2RLK
W1PCD
W8WEJ
W1EED

21 MHz CW 100
VE6TP
WB2UDF
WA6GLD
W0RRS
WA9OTH
W0DAK
WA9NSR

21 MHz CW 200
W4OPM

21 MHz Phone 100
WA2FQG
WA2SFP
K9PPX
W6YMV
WA4WTG
W9NNC
WA5DAJ
W8WRP
WA0OAI
WB2OBO
WA5LOB
W6MEM
K4VKW
WA1EUV
W2VBJ
K5HYB
WB2RLK
WA8FVK
W4SYL
W1EED
W1PCD
WA7BPS

21 MHz Phone 200

28 MHz Phone 200
W2PV (WA2SFP)

6 PM Registration & Social. 8:30 PM Firstnighter Round & Square Dance. Figures by Andy Anderson – Music by the Top Notches. Free Western Square Dance Demonstration. Casual or western dress, please. Sunday 7 AM Registration & Free Continental Breakfast. Largest Flea Market held in the Roanoke Division. All dealers invited. No fees. Contest – Homebrew – Mobilerig – QSL – Leftfoot Sending. Picnic area – Playground – Lunch – Displays – Traffic Session. Guest speaker: JOE GALESKI W4IMR. Registration $1.50 ea, 4 for $5.00. Write: Roanoke Valley ARC, Van Wimmer, Rt. 4, Box 446, Salem VA 24153.

COLOR ORGAN KITS $7.50. IC Power Supply Kit $2. IC's $.25. Computer Grade Electrolytic Capacitors $.35. XMTR Transistor TRW PT3690 $1. Used Variacs. Nuvistors. Catalog. Murphy, 204 Roslyn Ave., Carle Place NY 11514.

WABASH CO. AMATEUR RADIO CLUB'S Third Annual Hamfest, Sunday, May 23. Rain or shine! Door prizes, major prize drawing, Flea Market, Bingo for the XYL's, and much more. $1 donation for admission. For more information write to Bob Mitting, 663 N. Spring St., Wabash IN 46992.

MOTOROLA HT-100 Fantastic new unit used but a few months. 2 freq. .94-.94 & .28-.88, complete with charger $375.00. E. Agoston K8TTC, 11535 Dunham Rd., Northfield OH 44067.

DRAFTING SERVICE – For Hams, Engineers – Professionally Inked – Ready for Publication – 20 Years Experience – For information send SASE – R. Wildman, 8512 Acapulco Way No. 2, Stockton CA 95207.

FABULOUS OLD TIME RADIO SHOWS on tape. Drama, comedy, mystery. Catalog free. RADIO RERUNS, P.O. Box 724, Redmond WA 98052.

WANT TO BUY OR TRADE FOR: Surplus L-C-R bridge, 455kc panadapter. David Potter, 2844 San Gabriel, Austin TX 78705.

discount. WA5UNL, 5429 46th, Lubbock TX 79414.

HOBBYISTS – Electronic components at huge savings. Transistors, 2N3566 and 2N3567, 6 for 25¢, 2N3638, 4 for 25¢, capacitors 10¢, carbon resistors 5¢. Thousands of components. Catalogue free. SASCO Electronics, 1009 King St., Alexandria VA 22314.

THE SPRING AUCTION of the Rockaway Amateur Radio Club will be held Friday evening April 23rd at 8 p.m. at the American Irish Hall, Beach Channel Drive at Beach 81st St., Rockaway Beach NY. Come to the best Auction in the New York area. For further information write to Al Smith, WA2TAQ, P.O. Box 341, Lynbrook NY 11563.

WEST COAST HAMS buy their gear from Amrad Supply Inc. Send for flyer. 1025 Harrison St., Oakland CA 94607. 451-7755, area code 415.

MILITARY SURPLUS. All new. Electronics, devices, components. Compare and save. Catalog 10¢ (stamps or coin). Electronic Systems, P.O. Box 206, New Egypt NJ 08533.

FOR SALE – First copies 73 Magazine Vol 1 No. 1 Oct 1960 thru Dec 1962. Complete except for Nov 1960 issue. 26 issues in all, in mint condition. Make offer. A. S. Cooke, 21 St. Paul's Court, Brooklyn NY 11226.

GREENE – water tight center insulator with or without BALUN – a very tough item to beat – flier free. GREENE INSULATOR, Box 423, Wakefield RI 02880.

TWO 8281/4CX15000A w/sockets $200 ea; 75A4, Spkr, & 32V1 Mint $550.00; 4CX250B w/sockets $8.00 ea; Two KT-176/PRC-10 6 Mtr FM $20.00 ea. RA 74D for super pro $25.00. WA4YND, 210 Graeme Dr., Nashville TN 37210.

SWAN 350C transceiver 550 watts CW/SSB with calibrator, excellent condition, $400.00. Gary Jordan WA6TKT, 629 Manhattan Avenue, Hermosa Beach CA 90254. Includes 117XC power supply!

LETTERS

Article Index

In researching amateur radio articles via December issue indexes, I find that your Dec. 70 Index is possibly the *worst* in all of hamdom. Please change! Thank you.

Alfred A. Assaiante
213 St. James Pl
Merchantville NJ 08109

All right.

. . .Ken

160 Meters

Why don't you get out ahead of those other magazines and give us some articles on 160 meter homebrew gear of all kinds? A good transistorized receiver, QRP xmtr, and anything else that would fit in. There are still some of us who like to homebrew yet. And this is where I think we have lost our fire in ham radio. A shack full of homebrew gear will build up far more excitement than a shack full of commercial gear. Do enjoy the editorials and I think you've got a lot of the fellas thinking.

Lawrence H. Moore W7NJU
417 West 5th
Jerome ID 83338

We can't buy articles that you fellas don't write.

. . .Ken

Lifer

Enclosed is check for lifetime subscription to 73. 73 is the best all round amateur magazine on the market. Keep up the good work.

Thomas W. Barefoot WN4PVM

Straighten Up!

What's with all the sideways-printed material in the front of the magazine? I've been able to ignore it up to now, but with the Contents (& W2NSD/1) now askew, you've pushed me too far. How about straightening up and flying right?

Small, efficient, portable.

Perhaps: Take it all with you with a Ford Bronco 4-wheel-drive vehicle.

Now, while not all of Mr. Ford's or Mr. Honda's merchandise would be advertised, there are a few select products within these and other fields that most certainly would be interesting to radio amateurs.

You also seem unhappy that Collins Radio does not deem your magazine worthy of advertising dollars. Try this: First, discontinue all of those wonderful construction articles. After all, how do you expect one to buy Collins, when there are all those marvelous, current, state-of-the-art construction articles there? *Second,* in order to fill the magazine, initiate columns of Who's Who in DX, DX standings, and other trivial details, such as listing the top stations in a particular contest. This designed to foster in the readership an attitude of: "Gee, Joe Blow down the street has one more country than I do, I'd better get a Collins." "Hey, Al Pal across town worked more stations than I did during the last contest, I'd better get a new Collins." "Oh, boy, I slipped down in the DXCC standings, I'd better get a new Collins linear." *Third,* in my program, cancel my subscription, as when your magazine deteriorates this far, I will no longer be interested in it.

I have a poor opinion of Collins. I have never seen a demonstration by Collins where they did not cast aspersions on all amateurs who did not buy Collins equipment, and especially upon those who choose to build their own rigs. This includes the Cleveland Hamvention, the Dayton Hamvention, and guest speakers at our own local radio club.

At one, I witnessed a demonstration where the demonstration was a "homebrew" transmitter of innovative design, and the "operator" actually blew it up (a small fireworks display) and commented, "Well, if I'd bought Collins, I wouldn't have this trouble." Whereupon he launched into a lengthy speech about the wonderful Collins radios.

I sincerely hope you will find the foregoing suggestions helpful.

Michael R. Hanna K8UUO
6503 Orchard

couple of years, we'll have $60–70 5W 220 MHz transceivers for the hobby band. In fact, there will probably be a bigger technical advance with RM-1633 than even 2 meter FM.

As far as licensing goes, I'm a General and I'll be going for Advanced in a few months. I'm in favor of incentive licensing if for no reason than to have a more competent ham fraternity. I know I'd have never gone to the trouble to get an Advanced or Ex unless it was necessary. In fact, I'd like to think of the hobby band as sort of a "renewable sub-Novice." Maybe with the additional income, the FCC could get realistic on all license fees and back off the stiff tariffs.

Still is the best construction mag for my book. Keep up the good work. Oh by the way, the worst thing that could happen to 73 is to merge it with QST!! Just improve QST if anything.

Ed Manuel WA5GZD
7118 Kingsway
Houston TX 77017

I think 73 mag is the greatest, and if Wayne ever starts another radio organization or becomes director of ARRL, I'll be one of the first to join. 73's Advanced and Extra class study guides are outstanding.

Joseph E. Falletta Jr.
WB6UDO

Kill the Umpire!

How about looking around for another editor. Frankly, the magazine is not too interesting to a lot of us readers. It seems you are leaning more toward the VHF and many of us could care less for high frequency. RTTY UGH! The mag is not as good as it once was but then again QST is worse, and I have been subscribing to it for almost 50 yrs. On the other hand, maybe it is me; when you are 65 and retired, things seem to bother you more, you are not so permissive.

T. E. Burmeister W8BSS
862 Quarry Dr.
Cleveland OH 44121

Sorry, OM. 73 is trying to appeal to the young and active. So I can't see why you don't really dig QST.

. . .Ken

What can a 64-year-old SWL do to help to promote a new hobby channel.

Novice and have been so for almost a year now. Being very interested in amateur radio I feel that I am about ready to pursue the General class license. Between my electronic background, your study series on the General and the ARRL handbook I have the theory pretty well down. The thing I feel I need most is the code speed. I listen to the code session nightly over W1AW and the one thing that infuriates me to no end is the QRM that takes place on the same frequency. Not to completely rule out coincidence, but on 3.520 and 7.020 MHz, shortly before and after each session, is reasonably clear. As soon as the session starts though, it is sheer frustration to try to copy 13 or 15 wpm. So the object of my letter is to remind all hams, members and non-members of the ARRL, that they are not really hurting the League but hurting their fellow hams and would-be hams trying to better themselves in their chosen hobby. Thank you.

Thomas C. LawrenceWN4QLW
1704 Avondale Dr.
Altavista VA 24517

Licenses

Shame on Ravin' Dave (Leaky Lines, Jan. 73) Most of the techs I know got their licenses honestly and I do hope we get some 10-meter privileges. I'd like those privileges to be for CW operation since we techs have virtually no way of in-the-field improvement. As for Conditionals – I agree that the Conditional license is a great mistake. Provisions should be made for those for whom it is impossible to reach a testing station to receive their tests by mail, but I don't believe a ham should be denied the elements he has already passed when he wishes to upgrade his license.

We here in Idaho are fortunate to have two periodical testing stations – Spokane, Washington and Missoula, Montana. But some hams in North Dakota, South Dakota, and Montana are forced to travel great distances (over 300 miles) to take their tests in person. My suggestion is that the FCC take some of the money gained by license-fee increases and set up more twice-annual testing stations. Then the Conditional class could be done away with and those who feel they are too far to take their tests would have no

I think Wayne is trying to do for ham radio what Ralph Nader is trying to do for the nation as a whole. And I feel sure that the majority of the members of our group are of the same mind.

Fr Paul
St. Joseph Hospital
Ottumwa IA 52501

I like the January cover, but must we wait till she makes the centerfold of Playboy to find out her technical statistics?!

Mike K7LYK
116 Stewart St.
Seattle WA 98101

Eat your heart out.

. . .Ken

Repeater Info

I wish to congratulate your magazine on the repeater directory data in the April 1970 issue, no one should be without it.

Don S. Righello
Sec. Treasurer
CCARS

Personnel at this base are very much looking forward to your much needed repeater directory as they go to assignments all over the country from here. See you on 2m.

John W. Patterson WB4HKE/5
President, K5TYP
ABPS (AMATEUR RADIO)
Keesler AFB, Biloxi MS

We appreciate the attention you are giving to those interested in FM.

Ken Adams K4MOC
President, Carolina Repeater Society
Route 2, Box 311
Columbia SC 29203

The Long Run

Here in Reno, they are now doing big things with FM long hauls:

Local 146.94 goes to a remote base locally, which hauls it down to the QTH, and then it goes back up to the remote base and comes out on six meters. On 6 meters, it's passed on to Bishop (a long way off). It's picked up at Bishop and goes on 2 meters to Rogers Mountain, where it goes on 450 to W6SLR (Blue Ridge repeater, in California), and then out again on 146.94 . . . and we then wind up talk-material in the front of the magazine? I've been able to ignore it up to now, but with the Contents (& W2NSD/1) now askew, you've pushed me too far. How about straightening up and flying right?

J. H. Gilbreth
1168 Kenyon Dr.
Ft. Washington PA 19034

Since the news material in 73 is about 90° out of phase with the technical content of the magazine, it seems only reasonable to print it so. We do recognize that many readers have worn a deep rut in their handling of magazines and thus find it difficult to make the change required. For these unfortunate souls we have two possibly helpful suggestions. First they might consider learning to read vertically . . . after all the Chinese and Hebrew writings are this way . . . a little practice is all it takes. If this is too much trouble, perhaps night classes can be organized in the larger colleges to familiarize readers with the best methods of holding a magainze at 90°. These failing, we may be able to make a pair of 90° prism glasses available with longer term subscriptions. We will, of course, welcome any helpful suggestions from readers.

. . .Wayne

A Profit in the Biz

I am an avid fan and subscriber to your magazine, and may you continue publishing it past 73 years.

I was most disconcerted to learn that the magazine industry in Peterborough is not on a profitable basis.

If I may suggest, I believe the answer may be in the form of additional advertising, but not in the amateur radio field. You hit the point in your last editorial, mentioning Mr. Herter's slippers. While not all of Herter's merchandise would be of interest to all amateurs, most would certainly consider slippers to comfort the feet during long, tedius hours trying to get that new country. I envision: Do you have trouble staying awake throughout the long contest weekend? Falling asleep at 3 a.m.? Drink espresso coffee! It'll keep you awake!

Do you have trouble powering your rigs on field day? A Honda 3 kW generator will power your setup.

a lengthy speech about the wonderful Collins radios.

I sincerely hope you will find the foregoing suggestions helpful.

Michael R. Hanna K8UUO
6503 Orchard
Parma OH 44129

No, not too helpful, except that now we can stop worrying about Collins ever advertising in 73.

Green on Tonight

I have been reading 73 magazine for over two years and I've really enjoyed your great magazine. You have said many times that each and every ham has a responsibility to spread the word of ham radio to the public.

I think I have the answer to reach as many people as possible. Wayne Green needs to become a guest on Johnny Carson's Tonight TV show and tell the vast number of TV viewers the story of ham radio. Wayne could show some of his QSLs and maybe even have a sked set up so he could work someone on the show.

I think this would be a great way to tell the public of ham radio and make some new friends of the service.

Maybe some of our New York hams could get an invitation for Wayne.

William A. Barbee WA5ZXG
Lula MS 38644

Tell it to Johnny

. . .Wayne

The League and Wayne

The most constructive idea I've heard is that we support Wayne for president of the ARRL. Contrary to what some think, I think the worst thing that could happen is a new League. Look how many problems the American political system has with two parties. In fact, I'm even considering joining the League for the first time since I got my ticket in 1963 just to support Wayne.

I'm very glad to see constructive thinking still exists in amateur radio. A 220 MHz hobby band is a great idea, though I don't see a lot of difference in the idea as proposed, and the Technician; 5 wpm never was much of a code requirement. I am a CW op. Right now all I have is a Ten Tee PM3 in my shack. But get the band in use! Let's stop talking about CB'ers and non-ham hams, and get interested amateurs on that frequency. Who knows, maybe in a

the young and active. So I can't see why you don't really dig QST.

. . .Ken

What can a 64-year-old SWL do to help to promote a new hobby channel.

We think it would help to clear up the bootlegging and some TV interference and C B channels.

V. M. Blosser

Write your congressman suggesting immediate passage of RM-1633.

I am in the process of getting my license again after letting it lapse 20 years ago. Things have changed and your magazine helps me "catch-up" as well as it provides interesting articles and projects.

One problem I'm encountering, which might be one for other newcomers as well, is the extensive usage of abbreviations. This may seem ridiculous; however, I have few if any hams to ask such questions of. Perhaps an article in upcoming issues?

Chuck Gerttula
P. O. Box 47
Agate Beach OR 97320

Something for us to think about.

. . .Ken

WWV Via Drake

Here is a bit of information for Drake R-4B receiver owners that might be worth publishing: WWV can be received on the Drake R-4B receiver, without accessory crystals, by placing the controls in the following positions:

Band switch:	3.5 MHz
Xtals:	Any position
Preselector:	Approximately 5½ (tune for peak signal
Main tuning:	0.132 approximately
Other controls:	Normal positions for operating

I believe that this is the 5 MHz WWV signal, due to daytime poor signal propagation. After dark, the signal is excellent.

Louis Hodges W9LMI
Route 1, Box 117
Chester IL 62233

W1AW QRM

As we all know, there are a lot of corrections that should be made in the ARRL. Let me also say that there are some good points, too. One of these is the W1AW code practice. I am a

take some of the money gained by license-fee increases and set up more twice-annual testing stations. Then the Conditional class could be done away with and those who feel they are too far to take their tests would have no room for gripes.

Still enjoy 73 as much as ever and hope to see all the fine departments grow. I looked at a copy of QST the other day and found it the same outmoded DX gossip sheet as ever.

Cathy Beare WA7PEE-WA7PNQ
Box 65
Coocolalla ID 83813

Need CW Help

Just got January 73 and it is great. I really like inverted attic antennas, and I am considering the possibilities of a 40m array. Other articles enjoyed are *Amateur Study Guide* and *There is a Santa . . . But*.

Now, down to business. I am 13 and find radio interesting, though I have no ticket. I have the theory down but need HELP with CW. If anyone will help, drop me a line. (By the way I am building the transceiver in the December issue for 40m).

James Walroth
809 Depot St.
Youngwood PA 15697

Angels and Halos

I really liked your January cover of WA1JYV on her VW. Having the beautiful young lady pose with her halo was neat.

William A. Chanis WA5JCK
P.O. Box 259
Alvin TX 77511

A New Start

After reading "A New Start From Washington" (Feb) written by such a good oldtimer I want you to know that I am in full accord.

Consider using our ham call letter plates to help raise money to lobby for the desperately needed changes in our ham rules. Each ham who contributed would have a call letter plate or plates to show he personally was interested in bettering our hobby. If each ham were to sign a statement declaring that his name could be used in petitioning the FCC to legislate for better hamming (this statement could be worked into the order form) this would be to show the people in Washington that we as a group want a better hobby.

Bishop (a long way off). It's picked up at Bishop and goes on 2 meters to Rogers Mountain, where it goes on 450 to W6SLR (Blue Ridge repeater, in California), and then out again on 146.94 . . . and we then wind up talking to Los Angeles and/or Las Vegas.

It's awful, but it works and is great fun . . . till the ragchewers get on the channels and do things. . .

Want me to say that again?

Art Brothers W7NVY
Box 2124
Reno NV 89505

Makes me miss the good old days in the land where things happen.

. . .Ken

Mystery Woman

What's the story behind WA9XYZ?? No "X" calls are issued except for experimental stations from what I am lead to believe. Back in the early 60s there was a W9XYZ listed along with an "XYZ" in all the other call letter areas. The address listed for them was the same address in Illinois.

Now I find a picture of an XYL on news page 3 of the February issue with a similar call and not listed in a new Callbook. Any ideas?

Andrew C. Mueller
2222 Oaklawn Avenue
Waukesha WI 53186

None whatever.

. . .Ken

I had hoped that you were only experimenting with the new logo. I guess I was wrong. You must actually *like* to see 73 printed in that little sqinty-eyed type. I always thought of 73 as a modern, rather than "mod" magazine. You probably like maxi skirts and octagonal eyeglasses as well. My subscription is coming up for renewal – should I? (And I've been with you since 1961.) Please, let's see that big proud "73" like it always has been since the beginning on the cover.

Doug McGarrett WA2SAY
28 Holbrook Road
Centereach, L.I. NY 11720

OK. But you don't realize what kind of war you've started among the staff members, all of whom dig micro-miniskirts.

. . .Ken

What's really different about FM?

Ken Sessions K6MVH

If you're an active ham who uses sideband or AM, you're probably wondering why everyone is making such a fuss over all this 2 meter FM activity. Well, it does have a few things going for it. And it might even win *you* over. Take the ordinary receiver noise you're used to hearing, for example . . . it's one of the most undesirable characteristics of AM radio, but it's practically nonexistent with FM. The reason? Squelch! Highly efficient squelch circuits are standard equipment on FM receivers. These circuits keep *all* audio from the speaker until an *intelligible* signal appears on the frequency.

Then there's the matter of sensitivity: FM receivers are generally more sensitive than their AM equivalents. A threshold sensitivity figure of 0.2 μV is not at all uncommon. And in most FM receivers a signal of no more than one-half of a microvolt will give copy that couldn't be classed as anything less than S9! This compares to something on the order of 50 microvolts to accomplish the same end in an AM receiver. Pretty impressive so far, isn't it?

The most noticeable differences between AM and FM VHF, though, are the operational peculiarities. FM operation is unique among amateur modes in that it employs the "channel" concept. Transmitters and receivers are crystal-controlled to operate on any one of several discrete frequencies. No one ever "tunes in" another station or zero-beats a carrier. Since the FM channels are all standardized on the 2-meter band. new operators only need to learn what channels are the most active in their area. After an initial expenditure for a few crystals, "radioing" will require no more attention. From here on in, it's simply a matter of turning on the rig and listening to whatever signals come on. There's never a need to tune the transmitter, because once it's tuned up on a frequency, it will stay tuned up. And the channels are usually close enough to one another to preclude the necessity for retuning after even drastic channel changes.

This kind of operation is admittedly a little hard to get used to – especially for the devoted VHF AM man, who tweaks his transmitter every time he goes on the air, and who sits patiently running his receiver frequency control back and forth across the spot where he's just called CQ. Most of us who are new to FM feel a need to *do something* – and with FM, there's nothing *to* do. It's a bit maddening at first – but the whole concept gets appealing before long.

Domestic Considerations

I think FM has done more to bring harmony into hams' families than any other single element. Look at it objectively. Women don't like the noise of radio as a rule (if you can safely generalize about women). And they don't like competition. Until FM came along, there wasn't much we could do about the noise. AM squelches have never been effective because they keep out signals when they're set tight enough to keep out noise. To wives, the noise is distracting and bothersome. With FM, there is dead silence unless someone is actually using the frequency.

If you don't think regular hamming is competition for the wife, consider your routine operating habits. You get in the car and turn on the rig. (Your wife is sitting in the passsenger seat.) You lean over and tune up the transmitter – first the oscillator, then the multiplier stages, then the final – peak, dip, peak, dip.

Are you ready to start being a husband? Not quite. Now you're ready to make a contact. You've got a clear spot, so you call your CQ – and another couple of minutes are shot. After the CQ, you've got to tune around to see if there's someone who might have heard you. If nobody's right near the frequency, you figure maybe they're rockbound somewhere at the other end of the band, so you go hunting. And your wife just sits there like a bump on a log, maybe wishing you'd married the radio and she'd married that nice fellow who got to be president of the local bank.

Contrast all that with the way FM units are set up. You turn on the key to the car and the rig comes on – on channel, tuned up, ready to go. If you want to talk with someone, you say a word or two into the mike (no CQs, though, they're completely unnecessary). That's it. Now, if anyone is listening to the channel, he'll hear you. And if he feels like talking to you, he'll let you know.

That's really how wives get interested in radio, too. They see how simple it is to operate an FM unit, and suddenly they become interested. Many wives really kind of dig the idea of communicating, but they can't stomach all the peripheral tuning, loading, dipping, tuning jazz that accompanies the more conventional types of operation. That's why wives are frequently heard on FM, though rarely on SBB or AM.

Frequencies of Operation

Today there are 63 standard FM channels on 2 meters. Little more than a year ago there were but 31. The 31 channels were spaced at 60 kHz intervals, starting from 146.04 and extending to 147.84 MHz. As more and more people came into FM, the requirement for additional frequencies became apparent – particularly for additional channels reasonably close in frequency to the most popular of the older channels. The more ancient pieces of surplus FM equipment were set up for wideband operation (30 kHz bandwidth), so there wasn't much anyone could do about increasing the concentration of channels. Not then.

But finally, more modern equipment began to find its way into the ham market – equipment designed to operate within a bandwidth of not much more than 10 kHz. And specially designed amateur FM gear made the scene. So, as amateurs began to acquire this later vintage gear, they also began to "split" their channel spacing. Now, rather than establishing wideband channels at 60 kHz intervals, the FM'ers have established narrowband channels at alternate 30 kHz frequencies, as shown in Table I.

Even though the early 31 channels are earmarked for wideband operation, it is a fact that many users have abandoned their insistence for that mode. Many –,indeed most – of the active FM groups have settled on a compromise standard that consumes a bandwidth of around 20 kHz. This compromise allows use of the older wideband gear as well as the newer narrowband units within a single compatible communications system.

Not all the FM channels are active yet, of course, but the number is growing all the time. Those channels that lie between 146.31 and 147.0 are the most popular, with the lower channels being used chiefly for repeater inputs and the upper ones for repeater transmitting frequencies. Across the country, 146.94 MHz is the single most popular channel, and was once referred to as the national "calling frequency." The prominence of repeaters has pretty well eliminated the need for a calling channel per se, because where a repeater is there is generally a monitor on a continuous basis. Still, 146.94 is often used for point-to-

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I think FM has done more to bring harmony into hams' families than any other single element. Look at it objectively. Women don't like the noise of radio as a rule (if you can safely generalize about women). And they don't like competition. Until FM came along, there wasn't much we could do about the noise. AM squelches have never been effective because they keep out signals when they're set tight enough to keep out noise. To wives, the noise is distracting and bothersome. With FM, there is dead silence unless someone is actually using the frequency.

If you don't think regular hamming is competition for the wife, consider your routine operating habits. You get in the car and turn on the rig. (Your wife is sitting in the passsenger seat.) You lean over and tune up the transmitter – first the oscillator, then the multiplier stages, then the final – peak, dip, peak, dip.

Are you ready to start being a husband? Not quite. Now you're ready to make a contact. You've got a clear spot, so you call your CQ – and another couple of minutes are shot. After the CQ, you've got to tune around to see if there's someone who might have heard you. If nobody's right near the frequency, you figure maybe they're rockbound somewhere at the other end of the band, so you go hunting. And your wife just sits there like a bump on a log, maybe wishing you'd married the radio and she'd married that nice fellow who got to be president of the local bank.

Contrast all that with the way FM units are set up. You turn on the key to the car and the rig comes on – on channel, tuned up, ready to go. If you want to talk with someone, you say a word or two into the mike (no CQs, though, they're completely unnecessary). That's it. Now, if anyone is listening to the channel, he'll hear you. And if he feels like talking to you, he'll let you know.

That's really how wives get interested in radio, too. They see how simple it is to operate an FM unit, and suddenly they become interested. Many wives really kind of dig the idea of communicating, but they can't stomach all the peripheral tuning, loading, dipping, tuning jazz that accompanies the more conventional types of operation. That's why wives are frequently heard on FM, though rarely on SBB or AM.

Frequencies of Operation

Today there are 63 standard FM channels on 2 meters. Little more than a year ago there were but 31. The 31 channels were spaced at 60 kHz intervals, starting from 146.04 and extending to 147.84 MHz. As more and more people came into FM, the requirement for additional frequencies became apparent – particularly for additional channels reasonably close in frequency to the most popular of the older channels. The more ancient pieces of surplus FM equipment were set up for wideband operation (30 kHz bandwidth), so there wasn't much anyone could do about increasing the concentration of channels. Not then.

But finally, more modern equipment began to find its way into the ham market – equipment designed to operate within a bandwidth of not much more than 10 kHz. And specially designed amateur FM gear made the scene. So, as amateurs began to acquire this later vintage gear, they also began to "split" their channel spacing. Now, rather than establishing wideband channels at 60 kHz intervals, the FM'ers have established narrowband channels at alternate 30 kHz frequencies, as shown in Table I.

Even though the early 31 channels are earmarked for wideband operation, it is a fact that many users have abandoned their insistence for that mode. Many –,indeed most – of the active FM groups have settled on a compromise standard that consumes a bandwidth of around 20 kHz. This compromise allows use of the older wideband gear as well as the newer narrowband units within a single compatible communications system.

Not all the FM channels are active yet, of course, but the number is growing all the time. Those channels that lie between 146.31 and 147.0 are the most popular, with the lower channels being used chiefly for repeater inputs and the upper ones for repeater transmitting frequencies. Across the country, 146.94 MHz is the single most popular channel, and was once referred to as the national "calling frequency." The prominence of repeaters has pretty well eliminated the need for a calling channel per se, because where a repeater is there is generally a monitor on a continuous basis. Still, 146.94 is often used for point-to-point communications as well as repeater operation. And in areas where there are no repeaters, you're still likely to find a great deal of activity on 146.94.

The second "big" channel is 146.76 MHz. Where areas were very active on 146.94 on a "simplex" basis before the advent of the 2 meter repeater, the repeater groups have had to select an alternate. (Most have found that is is foolhardy to install a repeater whose output frequency is the same as that used by all the active hams in the area.) "Seven-six," as it is called, was a logical second choice because of its popularity as a simplex channel over various parts of the U.S. Today, a number of the heavily congested metropolitan areas (other than California) use seven-six as the prime repeater output. Chicago, many cities in Ohio, Washington (state), and the lower eastern seaboard are examples of areas where seven-six reigns supreme as a repeater output.

As stated, repeaters today are exceedingly popular. It is the exception where a fairly good-sized metropolis does not have at least one 2-meter repeater in operation. If you're thinking about buying an FM transceiver, You'd do well to check into the local situation. See if there's a repeater in your area (or two, or three) – then, when you order your rig, make sure you get enough crystals to make full use of all the repeaters within your range. (Be sure to check with the local groups before you do too much operating, though. Some repeaters are actually set up as clubs, and you must become a dues-paying member before you'll be welcomed on a regular basis.)

Deviation/Modulation

One word you'll hear a lot when you're operating FM is "deviation." This is roughly comparable with "modulation level" of AM; deviation, however, is a function of frequency variation (and, of course, bandwidth) rather than audio amplitude, even though they may seem the same from the point of view of the listener.

In general, the standard deviation level for amateurs is on the order of ±10 kHz (the compromise mentioned earlier between wideband and narrowband). If your transmitter is set up for anything much greater than this figure, your signal may be so broad that other stations cannot even detect your signal at all. Overdeviation looks like noise to a good receiver, and its squelch will lock you out. On the other hand, if your deviation level is set too low, your audio may be deficient in terms of apparent amplitude. And if your signal is weak into someone's receiver, his noise may be a lot louder than you are. At 10 kHz your signal should work out fairly well into a wideband receiver, and you should have no trouble getting into narrowband units if you don't hit the mike too hard. In commercial service, special deviation meters are used to make sure all the units within a communiciations system are uniform. But with amateur repeaters, things aren't that critical; you can ordinarily set it satisfactorily by adjusting the level while getting reports from one of the other fellows using the system.

Tones

You'll hear quite a lot about "tones" on FM (if you haven't been hearing it already). Why would amateurs be concerned about something so unlikely? In a word, the answer is "control." Repeaters often require simple switching sequences – perhaps to turn them on or off under certain circumstances, to change antennas, or to shift to an alternate frequency. As you probably already know, though, there is usually nobody manning the repeater physically; so the control switching must be accomplished via radio signals. If you could send ordinary dc signals over the air, the switching functions could be simplified, but of course that is quite impossible. The only practicable approach is to convert the control voltage to a type of signal that *can* be transmitted via rf. Here, tone signals qualify nicely.

An audio tone of a specific frequency can be detected from a large array of audio signals. If such a detector circuit is set up so as to key a relay whenever that particular tone signal is present, the remote switching problems are solved.

In commercial two-way service, repeaters and remote stations have been

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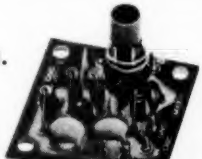
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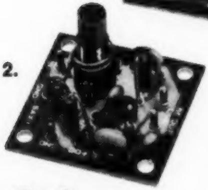
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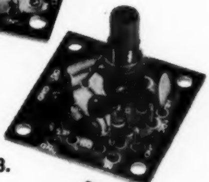
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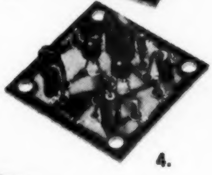
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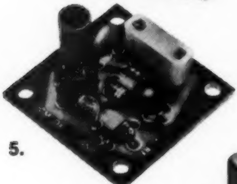
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6.

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using tone signals for years to control functions, and the result has been the standardization of specific tone frequencies. These, like FM channels themselves, appear at fixed intervals across the audio spectrum. Figure 1 shows the allocation of control frequencies currently in use by amateurs.

Notice that a frequency "block" at the lower end of the usable audio spectrum is set aside for control – this is in addition to the "channelized" control frequencies on the upper end.

Another block appears in the 1.5–1.65 kHz range. This portion of the spectrum is typically used for control of uncritical functions. This particular block is used because of the simplicity by which a control signal can be initiated. For example, when you pucker up and whistle, the signal you generate will fall in this "uncritical" block. And here is the spectrum used by those so-called "whistle-on" repeaters.

The control frequencies above the whistle-on block are set up at intervals of precisely 150 Hz. Officially, the "channels" are 1650, 1800, 1950, 2100, 2250, 2400, 2550, 2700, and 2850. These signal frequencies are far enough above the ordinary "voice" range that it is difficult to simulate the signals by whistling. So amateurs use simple electronic tone generators.

Many repeaters require the presence of a short "tone burst" as a prerequisite to causing the repeater to operate. The concept, called "tone burst entry," is very common where several repeaters overlap in coverage. Suppose, for instance, that you live in an area served by several repeaters, all of which use 146.34 MHz as their input frequency. It would be annoying for other users if you triggered all repeaters each time you transmitted. To obviate such a possibility, repeater groups will select certain tone frequencies for control. Thus, you might transmit a short tone of, say, 1950 Hz to trigger one of the repeaters, and another, of perhaps 2100 Hz for another. The whole business usually works out pretty well.

The block of low frequencies is used for the most critical applications, and normally where *continuous* control signals are required (as opposed to *tone bursts*). It is the rare repeater that uses these low frequencies (called *continuous tone carrier squelch system*) for control, however; so there is no need to go into any great detail about the

Table I. 2m FM Channel Allocations

NARROW	WIDE	NARROW	WIDE
146.01	*146.04*	*146.97*	*147.0*
146.07	*146.10*	*147.03*	*147.06*
146.13	*146.16*	*147.09*	*147.12*
146.19	*146.22*	*147.15*	*147.18*
146.25	*146.28*	*147.21*	*147.24*
146.31	*146.34*	*147.27*	*147.30*
146.37	*146.40*	*147.33*	*147.36*
146.43	*146.46*	*147.39*	*147.42*
146.49	*146.52*	*147.45*	*147.48*
146.55	*146.58*	*147.51*	*147.54*
146.61	*146.64*	*147.57*	*147.60*
146.67	*146.70*	*147.63*	*147.66*
146.73	*146.76*	*147.69*	*147.72*
146.79	*146.82*	*147.75*	*147.78*
146.85	*146.88*	*147.81*	*147.84*
146.91	*146.94*	*147.87*	

Note: Though there are no known wideband repeaters on channels designated as narrowband, it is not uncommon to operate narrowband repeaters on channels designated as wideband.

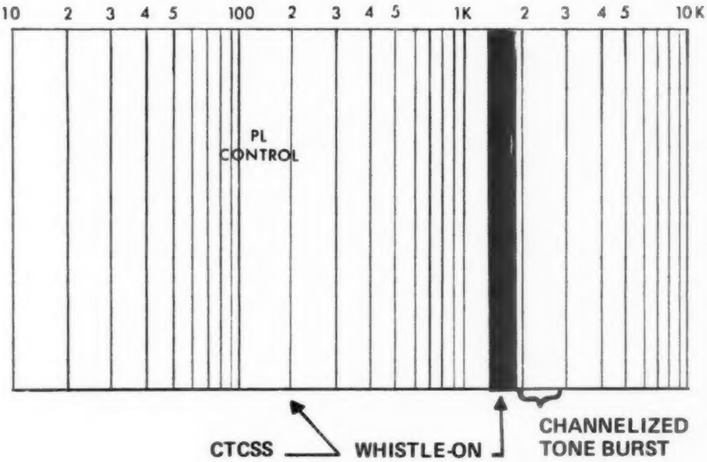

Fig. 1. Audio spectrun showing tone allocations.

applications and tone generation techniques.

What's It Like?

Do a little snooping. One of the most surprising characteristics you'll notice is the overall absence of those old cliches you hear so much on AM. Such expressions as "one-eyed monster," "snore shelf," "big switch," "bucket of bolts," "down the old log sheet," and "handle" have been in most cases replaced with their generic terms. It may seem hard to tear yourself away from those old habits, but you might even approve once you get the hang of it. Using generic terms makes your contact seem more like a real person, and not so much like a machine. One characteristic you're sure to notice is short transmission. When someone has something to say, he'll transmit briefly and say it, then drop his carrier. The FM'er has learned that long transmissions are about as effective as no transmission at all. Here's why: Heterodynes on FM are rare – so there is usually no QRM. When two stations transmit simultaneously, the stronger will "capture" the weaker in the listeners' receivers. So, when you talk, no one else can use the channel unless they clobber you. Also, most repeaters are set up with limit timers: If any one transmission exceeds a specific limit (between 1-1/5 and 3 minutes, usually), the repeater automatically shuts down and stays off the air until the longwinded individual himself goes off the air. And all the while it's off, the other users are fuming. Nobody can use the system as long as the diehard blowhard continues with his unwanted and unheard dissertation. To an AM'er accustomed to long, drawn-out transmissions, this may seem unfair. But most FM'ers feel there is nothing that requires more than a few minutes of air time to convey. The FM'ers can't QSY a few kilohertz to avoid the longwinded ham. They all realize that if they didn't talk over him, no one could use the channel. By all means talk. But save a few words for the next transmission. The repeater will still be there – and so will your listeners if you play it cool!.

The Last Word

I always like to admonish prospective new converts to FM. This mode is different – it's kind of like certain kinds of communicable diseases in that it will not only affect you but very likely your friends and family as well. Once you get going on FM, it's awfully hard to quit. For FM adds something to ham radio – it complements any station set up for any kind of activity. Just see for yourself.

...K6MVH■

aftermath: NOISE BLANKER that works

Robert Grenell, W8RHR
3926 Beech Street
Cincinnati OH 45227

Since my article, "Noise Blanker That Works," appeared in the April, 1970 issue of 73, I've been buried in requests for help, advice and information. In every case, I've tried to get answers off in not less than a couple of days, but the flood continues. Yes, there were a couple of mistakes, principally the omission of point A in the schematic. And, I'm afraid I was guilty of a couple of assumptions when I wrote the article.

First of all, I have revised the schematic, and it does include point A. However, I have substituted a 10 mH rf choke for the i-f transformer which was previously shown. Since this is a noise amplification circuit, the fact that it's broadbanded with the rf choke is not a problem. The choke has advantages in size, and eliminates one adjustment. . .and it works just as well as the tuned circuit. If you prefer to use an i-f transformer, no problem: Just make sure it's the same frequency as the i-f of your receiver or transceiver. I received an amazing number of inquiries about what frequency the i-f transformer should be!

Another set of inquiries was caused by my assumption that most hams would be using the blanker in a receiver. To my chagrin, it appears that about 4 out of 5 who wrote me intend to use it in a transceiver. To use the blanker in a transceiver, certain special considerations must be observed.

First, most transceivers (indeed, most modern receivers) do not have an i-f stage ahead of the selective circuitry. For maximum benefit from any blanker, it should be installed ahead of the filter. This necessitates using a cathode follower between the mixer and the filter, around which the blanker can operate. In the schematic, such a stage is shown as it would be installed in a typical transceiver.

The most important consideration in transceiver installations is brought about by the fact that the blanker is applied to the filter input, where both transmitted and received signals are present. If the transmitted sideband signal at this point is too strong, the blanker diode will clip, causing severe distortion, and possible

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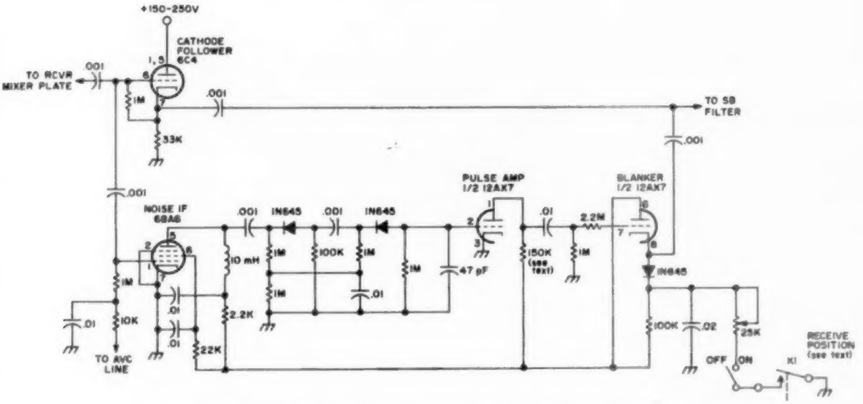
+150-250V
CATHODE FOLLOWER 6C4
1, 5
6
7
TO RCVR MIXER PLATE
.001
1M
33K
.001
TO SB FILTER
.001
PULSE AMP 1/2 12AX7
BLANKER 1/2 12AX7
.001
NOISE IF 6BA6
2
5
6
1
7
.001
1N645
.001
1N645
10 mH
1M
100K
1M
1M
1M
.01
47 pF
2
1
3
.01
150K (see text)
2.2M
1M
6
7
8
1N645
100K
.02
25K
OFF
ON
K1
RECEIVE POSITION (see text)
1M
10K
.01
TO AVC LINE
.01
.01
22K
2.2K

Fig. 1. Revised schematic of the noise blanker that really works!

splatter. Therefore, the blanker *must be deactivated* in the transmit mode. The only sure way to accomplish this is to use an open section of your TR relay to break the connection between the blanker on/off switch and ground when transmitting. If necessary, install an extra relay to do it. The importance of this point cannot be overemphasized. Failure to do this will not only make you sound like Donald Duck with a sinus infection and reduce your popularity with your fellow hams, but it could net you a pink ticket!

The input and output leads to the blanker must be shielded and short! At higher intermediate frequencies, excessive cable capacity can pull the tuned circuits or filter tuning capacitors too far off to peak up. The only solution is to use short leads, or compute the capacity of your cable and reduce the capacity in the tuned circuits by the same amount.

Do not overlook the connection to the avc line. Without avc, the blanker will clip excessively on strong signals.

In some cases, it is possible that more gain is needed in the first triode stage to get dependable blanking action. If this is the case, you can increase the value of the plate load resistor as far as necessary. You can even make it a kind of "starved circuit" amplifier, since we're dealing with dc pulses here, and frequency response is not important.

A large number of inquiries were received from hams who wanted to know what signal-induced voltages at various points in the blanker should be. These voltages depend greatly on the gain of the rf stage, the efficiency of the mixer, and the effectiveness of the avc action, not to mention the signal and noise levels encountered – too many variables to consider. Also, it is impossible to measure many of these voltages, since they are instantaneous noise peaks. Only a scope could serve the purpose.

When the blanker is activated, there will be a slight (1 to 2 dB) decrease in signal levels – just enough to notice. But noise will decrease dramatically. On extremely strong signals, particularly AM, there may be some clipping distortion from the diode when the blanker is activated. There is no cure for this, but then you don't need the blanker for strong signals, anyway, so turn it off.

Installed as demonstrated in the revised schematic, the blanker is truly universal and foolproof. Please don't hesitate to contact me if you experience difficulties in getting it going. I'm working on a solid-state version using the same basic principles. Watch for it. It should be better, offering faster blanking action. 73 readers will be the first to hear about it.

. . . W8RHR ■

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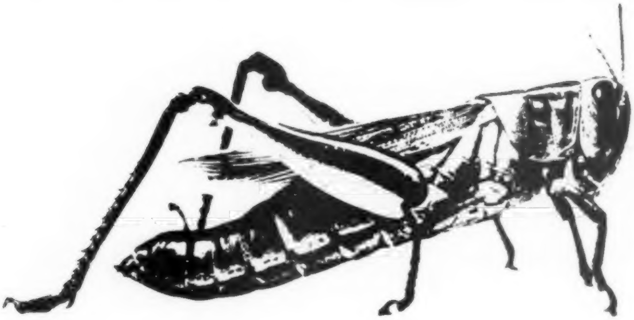

Donald L. Milbury W6YAN
Box 463
West Covina CA 91790

Technological Locusts That Plague The Age Of Repeaters

The heavy loading of active frequency channels on the amateur radio spectrum around metropolitan areas has produced increasing problems of interference – especially that ol' debbil called intermod. The combinations of frequencies that can mix together and produce intermodulation interference on a given frequency are practically countless. But the product chart of Table I does list the intermod products of the more commonly used 2 meter FM channels. By comparing this list of possible interfering frequencies against the frequencies in use in your own area, you should be able to narrow the search for the specific interfering frequencies. The products tabulated on this chart are derived from the equation 2A-B or 2B-A, where A and B are the mixing frequencies. Most intermod interference problems will result from this third order intermod product.

Other Causes of System Degradation

Transmitter noise. Transmitter noise interference results from transmitter broadband noise radiation which is received on frequency and degrades or masks the desired signal. In general, transmitter noise is the result of noise components generated in the lower frequency multiplier stages being amplified through the final power amplifier and passed on to the antenna through the relatively broad selectivity of the amplifier output circuits. Transmitter noise generally is the dominant interference factor (over desensitization) at frequency separations up to 1 MHz.

In the present state of the art, it is even higher for solid-state devices than for circuits built around vacuum-tube designs.

Receiver Desensitization. Receiver desensitization is caused by strong, off-frequency signals that enter the front end of the receiver, driving it into saturation and thereby desensitizing the front end to the desired on-frequency signal.

The sorry fact is, any vacuum tube amplifier subjected to excessive grid drive voltages will draw grid current and undergo a shift in operating point. Depending on the circuit used, this grid current will produce a self-bias grid voltage. When a high bias voltage exists, it takes a correspondingly larger signal voltage to overcome the bias voltage before the tube can act as an amplifier. That's life.

Since a strong interfering signal cannot be completely eliminated from the rf stages, this signal can produce grid bias voltages which require stronger-than-normal signals to overcome the bias. This reduces the effective receiver sensitivity. The effect is principally noted in the second mixer. When the desensitization threshold is exceeded by a strong signal, the gain in the second mixer is reduced because of the signal amplification prior to the second mixer. As the level of the undesired signal becomes extreme, the first mixer is also affected.

Back to Intermod. Intermodulation is defined as the production, in a nonlinear transducer element, of frequencies corresponding to the sums and differences of the fundamentals and harmonics of two or more frequencies which are transmitted through the transducer. When two or more of these frequencies are "mixed," an infinite number of new frequencies are generated. Only a few, however, are located in that portion of the spectrum near the fundamental mixing frequencies.

The general equation for the intermodulation products is:

$$F_{IM} = NB_1 \pm N_2 (B-A)$$

Where A and B are the two mixing frequencies.

By substituting values of N_1 and N_2 of the equation, one can see that an infinite number of odd- and even-order intermod products are generated when two frequencies are mixed. However, the even-order intermod products occur at frequencies well out of range of the problem area while the odd-order intermod products have frequencies which are close to the mixing frequencies. Figure 1 shows the spectrum of these products in relationship to mixing frequencies A and B. These are the frequencies which are most apt to cause interference problems.

The above discussion includes the intermod products of only two frequencies. A situation could exist where three or more frequencies mix to produce a product which could interfere with a system.

Diagnosis of Interference Problem

If one is faced with the problem of intermodulation interference, it would be extremely helpful to know the frequency of at least one of the signals being mixed. Often it can be recognized immediately

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Table I. Intermod Product Chart

	146.40	146.43	146.46	146.69	146.52	146.55	146.58	146.61	146.64	146.67	146.70	146.73
145.22	146.04	146.01	145.98	145.95	145.92	145.89	145.86	145.83	145.80	145.77	145.74	145.71
146.25	146.10	146.07	146.04	146.01	145.98	145.95	145.92	145.89	145.86	145.83	145.80	145.77
146.28	146.16	146.13	146.10	146.07	146.04	146.01	145.98	145.95	145.92	145.80	145.86	145.83
146.31	146.22	146.19	146.16	146.13	146.10	146.07	146.04	146.01	145.98	145.95	145.92	145.89
146.34	146.28	146.25	146.22	146.19	146.16	146.13	146.10	146.07	146.04	146.01	145.98	145.95
146.37	146.34	146.31	146.28	146.25	146.22	146.19	146.16	146.13	146.10	146.07	146.04	146.01
146.40	146.40	146.37	146.34	146.31	146.28	146.25	146.22	146.19	146.16	146.13	146.10	146.07
146.43	146.46	146.43	146.40	146.37	146.34	146.31	146.28	146.25	146.22	146.19	146.16	146.13
146.46	146.52	146.49	146.46	146.43	146.40	146.37	146.34	146.31	146.28	146.25	146.22	146.19
146.49	146.58	146.55	146.52	146.49	146.46	146.43	146.40	146.37	146.34	146.31	146.28	146.25
146.52	146.64	146.61	146.58	146.55	146.52	146.49	146.46	146.43	146.40	146.37	146.34	146.31
146.55	146.70	146.67	146.64	146.61	146.58	146.55	146.52	146.49	146.46	146.43	146.40	146.37
146.58	146.76	146.73	146.70	146.67	146.64	146.61	146.58	146.55	146.52	146.49	146.46	146.43
146.61	146.82	146.79	146.76	146.73	146.70	146.67	146.64	146.61	146.58	146.55	146.52	146.49
146.64	146.88	146.85	146.82	146.79	146.76	146.73	146.70	146.67	146.64	146.61	146.58	146.55
146.67	146.94	146.91	146.88	146.85	146.82	146.79	146.76	146.73	146.70	146.67	146.64	146.61
146.70	147.00	146.97	146.94	146.91	146.88	146.85	146.82	146.79	146.76	146.73	146.70	146.67
146.73	147.06	147.03	147.00	146.97	146.94	146.91	146.88	146.85	146.82	146.79	146.76	146.73
146.76	147.12	147.09	147.06	147.03	147.00	146.97	146.94	146.91	146.88	146.85	146.82	146.79
146.79	147.18	147.15	147.12	147.09	147.06	147.03	147.00	146.97	146.94	146.91	146.88	146.85
146.82	147.24	147.21	147.18	147.15	147.12	147.09	147.06	147.03	147.00	146.97	146.94	146.91
146.85	147.30	147.27	147.24	147.21	147.18	147.15	147.12	147.09	147.06	147.03	147.00	146.97
146.88	147.36	147.33	147.30	147.27	147.24	147.21	147.18	147.15	147.12	147.09	147.06	147.03
146.91	147.42	147.39	147.36	147.33	147.30	147.27	147.24	147.21	147.18	147.15	147.12	147.09
146.94	147.48	147.45	147.42	147.39	147.36	147.33	147.30	147.27	147.24	147.21	147.18	147.15
146.97	147.54	147.51	147.48	147.45	147.42	147.39	147.36	147.33	147.30	147.27	147.24	147.21
147.00	147.60	147.57	147.54	147.51	147.48	147.45	147.42	147.39	147.36	147.33	147.30	147.27
147.03	147.66	147.63	146.60	147.57	147.54	147.51	147.48	147.45	147.42	147.39	147.36	147.33
147.06	147.72	147.69	147.66	147.63	147.60	147.57	147.54	147.51	147.48	147.45	147.42	147.39
147.09	147.78	147.75	147.72	147.69	147.66	147.63	147.60	147.57	147.54	147.51	147.48	147.45
147.12	147.84	147.81	147.78	147.75	147.72	147.69	147.66	147.63	147.60	147.57	147.54	147.51
147.15	147.90	147.87	147.84	147.81	147.78	147.75	147.72	147.69	147.66	147.63	147.60	147.57
147.18	147.96	147.93	147.90	147.87	147.84	147.81	147.78	147.75	147.72	147.69	147.66	147.63
147.21	148.02	147.99	147.96	147.93	147.90	147.87	147.84	147.81	147.78	147.75	147.72	147.69
147.24	148.08	148.05	148.02	147.99	147.96	147.93	147.90	147.87	147.84	147.81	147.78	147.75
147.27	148.14	148.11	148.08	148.05	148.02	147.99	147.96	147.93	147.90	147.87	147.84	147.81
147.30	148.20	148.17	148.14	148.11	148.08	148.05	148.02	147.99	147.96	147.93	147.90	147.87
147.33	148.26	148.23	148.20	148.17	148.14	148.11	148.08	148.05	148.02	147.99	147.96	147.93
147.36	148.32	148.29	148.26	148.23	148.20	148.17	148.14	148.11	148.08	148.05	148.02	147.99
147.39	148.38	148.35	148.32	148.29	148.26	148.23	148.20	148.17	148.14	148.11	148.08	148.05
147.42			148.38	148.35	148.32	148.29	148.26	148.23	148.20	148.17	148.14	148.11
147.45					148.38	148.35	148.32	148.29	148.26	148.23	148.20	138.17
147.48							148.38	148.35	148.32	148.29	148.26	138.23
147.51									148.38	148.35	148.32	148.29
147.54											148.38	148.35
147.57												

where the interfering signal is intelligible. Also it is likely that one of the interfering transmitters is located geographically close to the receiver. If, on the other hand, neither frequency is known, the problem gets more complex. In a large metropolitan area there could be many possible combinations of frequency channels which could be mixing and producing interference.

Once the interfering frequency is known, the source of the mixing must be found. The intermod product is produced in a nonlinear element which could be in the power amplifier of a transmitter or in the front end stages of a receiver. In some cases, the mixing can occur at some point outside the transmitter or receiver, such as a poor antenna-to-tower connection, or even a rusty drain pipe.

Using the Intermod Product Chart. The channels involved are listed at the left side of the chart and again at the top of the chart. By moving down a column headed by a frequency at the top and moving across a row headed by a frequency at the left, you can find the intermod product of these two frequencies at the intersection of the column and the row (as you find the distance between cities on a road map mileage chart). The most convenient starting point on the chart will be found on the page where your operating frequency is listed at the top and also on the left. At the intersection of this row and column you will also find your operating frequency. From this point on the chart you can begin listing the possible interfering frequencies. The intermod product at your operating frequency will appear periodically on the chart to the left and right of the starting point. A pattern is established by moving up one row and to the left two columns, and by moving to the right two columns and down one row. The intermod product appears both to the left and right of the starting point for several pages. Wherever this product appears on the chart, it will occur at the intersection of the column and row headed by the possible interfering frequencies.

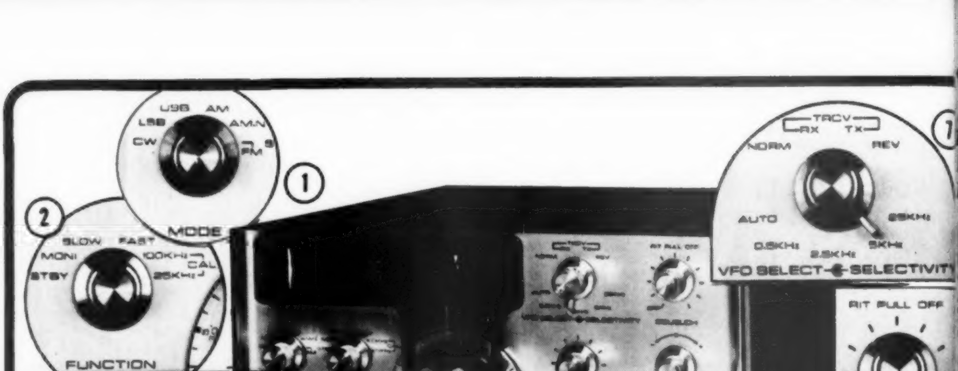
for 2M FM Channels

146.76	146.790	146.82	146.85	146.88	146.91	146.94	146.97	147.00	147.03	147.06	147.09	147.12
145.68	145.65											
145.74	145.71	145.68	145.65									
145.80	145.77	145.74	145.71	145.68	145.65							
145.86	145.83	145.80	145.77	145.74	145.71	145.68	145.65					
145.92	145.89	145.86	145.83	145.80	145.77	145.74	145.71	145.68	145.65			
145.08	145.95	145.92	145.89	145.86	145.83	145.80	145.77	145.74	145.71	145.680	145.65	
146.04	146.01	145.08	145.95	145.92	145.89	145.86	145.83	145.80	145.77	145.74	145.71	145.68
146.10	147.07	146.04	146.01	145.98	145.95	145.92	145.89	145.86	145.83	145.80	145.77	145.74
146.16	146.13	146.10	146.07	146.04	146.01	145.98	145.95	145.92	145.89	145.86	145.83	145.80
146.22	146.19	146.16	146.13	146.10	146.07	146.04	146.01	145.98	145.95	145.92	145.89	145.86
146.28	146.25	146.22	146.19	146.16	146.13	146.10	146.07	146.04	146.01	145.98	145.95	145.92
146.34	146.31	146.28	146.25	146.22	146.19	146.16	146.13	146.10	146.07	146.04	146.01	145.98
146.40	146.37	146.34	146.31	146.28	146.25	146.22	146.19	146.16	146.13	146.10	146.07	146.04
146.46	146.43	146.40	146.37	146.34	146.31	146.28	146.25	146.22	146.19	146.16	146.13	146.10
146.52	146.49	146.46	146.43	146.40	146.37	146.34	146.31	146.28	146.25	146.22	146.19	146.16
146.58	146.55	146.52	146.49	146.46	146.43	146.40	146.37	146.34	146.31	146.28	146.25	146.22
146.64	146.61	146.58	146.55	146.52	146.49	146.46	146.43	146.40	146.37	146.34	146.31	146.28
146.70	146.67	146.64	146.61	146.58	146.55	146.52	146.49	146.46	146.43	146.40	146.37	146.34
146.76	146.73	146.70	146.67	146.64	146.61	146.58	146.55	146.52	146.49	146.46	146.43	146.40
146.82	146.79	146.76	146.73	146.70	146.67	146.64	146.61	146.58	146.55	146.52	146.49	146.46
146.88	146.85	146.82	146.79	146.76	146.73	146.70	146.67	146.64	146.61	146.58	146.55	146.52
146.94	146.91	146.88	146.85	146.82	146.79	146.76	146.73	146.70	146.67	146.64	146.61	146.58
147.00	146.97	146.94	146.91	146.88	146.85	146.82	146.79	146.76	146.73	146.70	146.67	146.64
147.06	147.03	147.00	146.97	146.94	146.91	146.88	146.85	146.82	146.79	146.76	146.73	146.70
147.12	147.09	147.06	147.03	147.00	146.97	146.94	146.91	146.88	146.85	146.82	146.79	146.76
147.18	147.15	147.12	147.09	147.06	147.03	147.00	146.97	146.94	146.91	146.88	146.85	146.82
147.24	147.21	147.18	147.15	147.12	147.09	147.06	147.03	147.00	146.97	146.94	146.91	146.88
147.30	147.27	147.24	147.21	147.18	147.15	147.12	147.09	147.06	147.03	147.00	146.97	146.94
147.36	147.33	147.30	147.27	147.24	147.21	147.18	147.15	147.12	147.09	147.06	147.03	147.00
147.42	147.39	147.36	147.33	147.30	147.27	147.24	147.21	147.18	147.15	147.12	147.09	147.06
147.48	147.45	147.42	147.39	147.36	147.33	147.30	147.27	147.24	147.21	147.18	147.15	147.12
147.54	147.51	147.48	147.45	147.42	147.39	147.36	147.33	147.30	147.27	147.24	147.21	147.18
147.60	147.57	147.54	147.51	147.48	147.45	147.42	147.39	147.36	147.33	147.30	147.27	147.24
147.66	147.63	147.60	147.57	147.54	147.51	147.48	147.45	147.42	147.39	147.36	147.33	147.30
147.72	147.69	147.66	147.63	147.60	147.57	147.54	147.51	147.48	147.45	147.42	147.39	147.36
147.78	147.75	147.72	147.69	147.66	147.63	147.60	147.57	147.54	147.51	147.48	147.45	147.42
147.84	147.81	147.78	147.75	147.72	147.69	147.66	147.63	147.60	147.57	147.54	147.51	147.48
147.90	147.87	147.84	147.81	147.78	147.75	147.72	147.69	147.66	147.63	147.60	147.57	147.54
147.96	147.93	147.90	147.87	147.84	147.81	147.78	147.75	147.72	147.69	147.66	147.63	147.60
148.02	147.99	147.96	147.93	147.90	147.87	147.84	147.81	147.78	147.75	147.72	147.69	147.66
148.08	148.05	148.02	147.99	147.96	147.93	147.90	147.87	147.84	147.81	147.78	147.75	147.72
148.14	148.11	148.08	148.05	148.02	147.99	147.96	147.93	147.90	147.87	147.84	147.81	147.78
148.20	148.17	148.14	148.11	148.08	148.05	148.02	147.99	147.96	147.93	147.90	147.87	147.84
148.26	148.23	148.20	148.17	148.14	148.11	148.08	148.05	148.02	147.99	147.96	147.93	147.90
148.32	148.29	148.26	148.23	148.20	148.17	148.14	148.11	148.08	148.05	148.02	147.99	147.96
148.38	148.35	148.32	148.29	148.26	148.23	148.20	148.17	148.14	148.11	148.08	148.05	148.02

Example 1: Neither Frequency is Known. If your receiver frequency is 146.94 MHz refer to the spot on the chart where 146.94 MHz occurs at the top and the left side of the page. Moving to the side and up (and down) as indicated above, you'll find the frequency occurs at the intersection of the column and row headed by 146.88 MHz and 146.91 MHz, both of which are possible interfering frequencies. By continuing on in this manner both to the left and right of starting point, you will find many combinations of channels which may be interfering with you. A knowledge of the channels in your area will probably narrow the possibilities to only a few channels.

Example 2. One Frequency is Known. If one of the interfering frequencies is known, the other frequency can easily be found. For example, assume that intermod interference is being experienced in a receiver operating on 146.94 MHz. One of the interfering or mixing frequencies is intelligible, and known to be operating at, say, 146.82 MHz. To find the other mixing frequency, follow a two-step procedure. First, locate the 146.94 MHz product on the chart under the 146.82 MHz column and note that it intersects the row corresponding to 146.88 MHz. This frequency, 146.88 MHz, can be the unknown frequency (2A-B where A is 146.88 and B is 146.82). Next locate the 146.94 MHz product in the chart where it appears on the row opposite 146.82 MHz (left columns) and note it is under the column headed by 146.70 MHz. This frequency, 146.70 MHz, can also be the unknown frequency (2A-B where A is 146.82 MHz and B is 146.70 MHz). Of course there are other equations that will produce intermodulation products, and intermodulation is not the only form of interference. The intermodulation product chart will be of assistance to you in showing a few of the combinations that can affect your system and through your owr refinement and application of the chart, it can be of benefit to you.

W6YAN■



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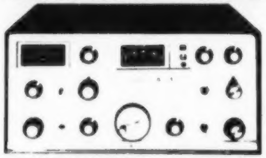

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Hotrodding Motorola's hybrid H-T's

The old H23 Handie-Talkie was a hybrid job: The receiver was a mishmash of vacuum tubes and transistors. This article tells how to eliminate the tubes in these early versions and end up with an all-transistor receiver capable of easily outperforming the later stock units.

Motorola introduced the first commercially available transistorized portable FM transceivers some time around 1956. These beautiful little units are now widely available to amateurs, but they come in a bewildering assortment of type numbers. For example, a P33-4 is a single-frequency transceiver for the 144 — 174 MHz region with 7 watts output, microphone, speaker, and rechargeable nickel — cadmium battery; an H23AAC-310AH is a high-band split-channel one-watt unit with handset and extra-duty dry battery.

The year 1956 was such a short time ago that it is sometimes startling to remember that available transistors at that time would not oscillate above about 1 MHz — and anything above that was vacuum tube country. So it was that the local oscillator and the two first i-f's of the Motorola HT receivers used vacuum tubes. Later units were completely transistorized, and a conversion kit is still available from Motorola (NED6004A, $74.00) which updates the early receivers to the fully transistorized configuration. If your unit has the late-model receiver, go immediately to some other article, because the remainder of this one will just make you wish you hadn't splurged on the nonhybridized vintage.

Using inexpensive N-channel field-effect transistors, the early receivers can be readily converted to fully solid-state operation, and these modified receivers will perform rings around the newer units (which use bipolar transistors rather than the hotter FET's). The necessary modifications will cost about $7, and the work can be finished in little more than an hour.

The FET cascode shown in Fig. 1 is generally useful as a pentode vacuum tube replacement. The transistors specified are readily available either locally or from the larger mail-order supply outlets. Other N-channel FET's, such as 2N3823 and those of the Motorola MPF series, will work equally well. In this application, the supply potential of 50 volts is just right as the two FET's are in series for dc and each gets about 27 volts from drain to source. Resis-

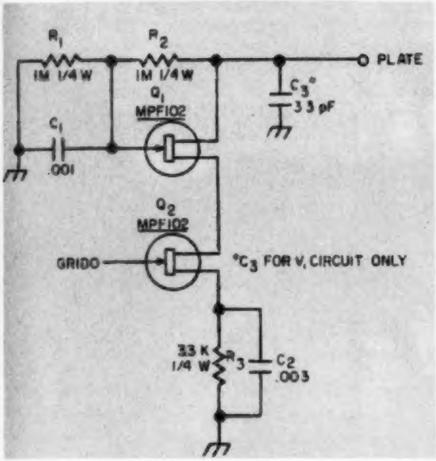

Fig. 1. FET cascode arrangement replaces each pentode i-f amplifier in the H23 hybrid receiver. Note that C_3 is required for the first i-f amplifier, though it is not used in the second.

tor R_3 determines the current drawn by the series transistor pair. The current in milliamperes is approximately $2000/R_3$. More than adequate gain is obtained at a current of 600 microamperes, and with the higher gains obtained at higher currents, stability problems can arise.

The output capacitance of this circuit is negligible, so that C_3 is required to correctly tune the output of the V_1 tube replacement. There is sufficient capacity in the output circuit of the second stage (V_2) so that a C_3 equivalent is not required.

Vacuum tube V_3 is triode-connected, so a single FET is used. Capacitors C_4 and C_5 return the crystal operating frequency to that of the original tube circuit. Resistor R_5 drops the 60-volt B+ to a level that is safe for the FET.

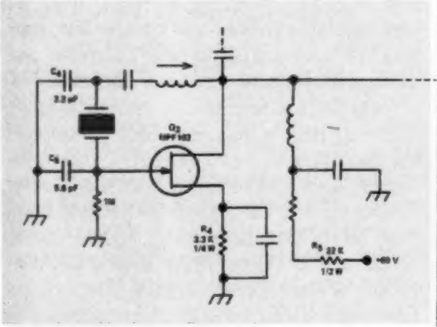

Fig. 2. FET replaces vacuum tube in the H23 oscillator to complete the transistorization operation. Components not labeled in the sketch are those components that are already part of the existing oscillator circuit.

As a last touch, replace the first crystal-mixer diode CR_1 (it will be a 1N72 or a 1N147A) with an HP 5082-2800 *hot carrier* diode. This will only cost a buck, and the expense is worthwhile. My own wideband H23AAM measures better than 0.4 microvolt sensitivity at 20 dB of quieting, and adjacent-channel problems due to cross modulation have disappeared.

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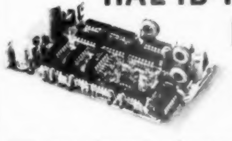

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stability without crystals

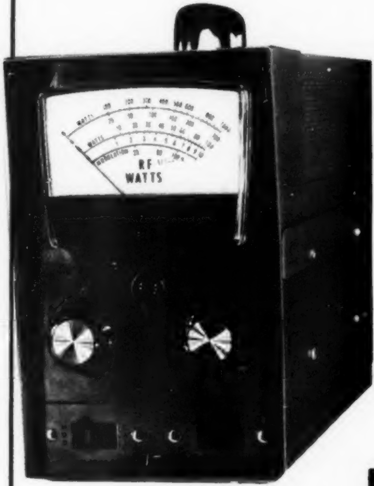
a new concept in "crystal" control

The government's way of solving problems is to offer long-range legislation in the form of technological targets to be aimed at by an industry. For air pollution, the federal government set an orderly pattern of increasingly rigid specifications with regard to auto exhaust emissions; and the auto industry must continue to reduce the polluting gases from their products in a continuing series of year-to-year improvements. The only alternative for the industry is to give up the manufacture of internal combustion engines.

The FCC has taken the same course with commercial radio. The problem is the perennial "spectrum squeeze," whereby more users demand more frequencies for more purposes than ever before. One of the approaches was the "splitting" of commercial channels to get twice as many users in a given band. This was accomplished by cutting the maximum bandwidth of user stations by two thirds, spacing channels at half their original distance, and tightening up the frequency tolerances of operating stations. The next step is the further tightening of operating frequency tolerances.

The future calls for frequency adherence to such a degree that ordinary crystal oscillators can no longer provide the stability required for legal operation; for this reason, several firms are busily engaged in projects to either improve the stability of crystal oscillators or replace the crystal altogether. In the immediate future, FCC requirements call for a frequency stability of 99.99975% for base stations (allowing only a maximum frequency error of 0.00025%). For mobiles, with stability problems that will be compounded by changing battery voltages and temperature extremes, the allowable error will be 0.0005%. It is hardly necessary to say that many – indeed, most – commercial two-way radios are not capable of meeting this new tolerance requirement without extensive modification or outright replacement.

Of all the approaches being considered by the various manufacturers, the one that appears the most promising is Sentry Manufacturing Company's MODCOM idea. The MODCOM is a very highly stable crystal-less oscillator built into a conventional crystal oven container. Its most interesting characteristic is the fact that it plugs directly into the crystal socket of existing radio units, and achieves the stability required by the FCC without necessitating any actual modification.



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When the Sentry people sent out advance literature describing the plug-in MODCOM units, 73 was on the mailing list. A quick call to the manufacturer was all it took to get 73 lined up with an evaluation model, set up for operation in a 450 MHz GE Progress Line receiver.

In outward appearance, the unit looked for all the world like an ordinary crystal oven – though slightly taller. But there's where the resemblance ended.

The unit was presented to a couple of local amateurs who operate a remote transmitter on a cold, cold New Hampshire mountaintop. The two were Bob (W1JJO) and Dick (W1KGZ), who would test the unit under the adverse conditions of New England's uncomfortable winter environment. They also agreed to make stability measurements at elevated temperatures, which they simulated by applying heat inside the mountaintop building for long periods.

The results of these extensive tests made a very short story: no drift. Perhaps the MODCOM performed *too* satisfactorily, for the 450 MHz "test" unit is still being used at the remote site (the WA1KFV repeater). According to Dick, ambient temperatures in excess of 120° have failed to shift the compensated oscillator element. And discriminator readings show that daily drops to –20° (below zero) are incapable of causing noticeable frequency drift.

According to Sentry representatives, the MODCOM offers a number of corollary advantages by virtue of its direct "plug-in" feature. For example, in addition to bringing the radio within the new restrictive FCC guidelines, the module will eliminate such common problems as sticking oven contacts, contact and thermal noise, and long warmup time. The units are fully solid-state, and use the oven voltage to power the internal micro circuitry.

Another advantage is power consumption – or lack of it. By replacing a snap-action oven with Sentry's MODCOM oscillator module, actual power consumption in the oven circuit is cut by a factor of 25 to 1.

. . . Staff■

SWITCHING REMOTE LINEARS

The Tranx Circuit (73, April '66, page 76) for switching the plate supply of a linear amplifier was exactly what I was looking for, having just built up a 25W mobile linear to follow a Johnson Messenger CB rig when used on 10 meters. The Tranx circuit, in case you missed it, is a very small device consisting of a diode (to rectify a little rf picked up from the exciter), two transistors, and a relay. The realy then turns the amplifier off and on as the exciter is keyed.

The only change I had to make in adapting it to 10 meters (the originator of the circuit used it on 2 meters) was in the method of picking up the rf voltage feeding the diode. I simply wrapped four turns of 24 AWG insulated wire around the lead from the input SO239 to the amplifier grid, and ran the end of it through a 1K resistor to ground to provide a dc return for the diode.

But since my linear was to be mounted in the automobile trunk, this still left me with the small problem of finding a neat and easy way to disconnect the 12V filament and power input when the Messenger was to be used on the CB band. Borrowing a scheme from commercial two-way radio design, I ran the dc input to the linear through a relay, the control voltage for which was carried by the inner conductor of the RG-58 coax feedline from the exciter. Isolation is provided at each end by 0.01 capacitors and rf chokes, as shown in **Fig. 1**.

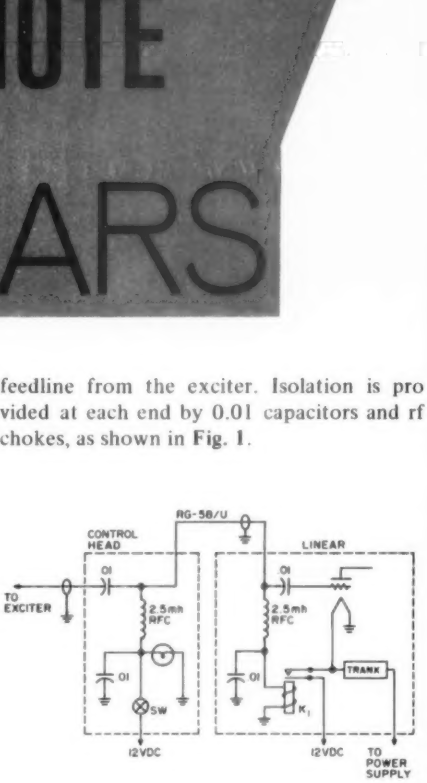

Fig. 1. Remote switching of linear amplifier.

Up front, the control head consists of a small aluminum bracket mounted under the dash, bearing the off-on switch, two capacitors and an rf choke, and a red indicating lamp to show when the linear filament is on.

Because of the low-impedance line, the rf chokes are completely effective in separating the dc from the rf—and operation is reliable and loss-free.

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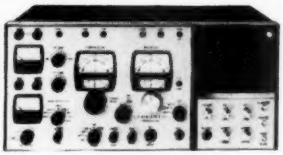

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Using Microwave for Repeater Links

Technical considerations in using microwave links for interconnectin fixed VHF repeater

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Not too many years ago, "higher frequencies" referred to the VHF and UHF bands, with the then-new concept of line-of-sight propagation. Then came the microwave frequencies – 2, 4, and 6 GHz – where the signal behaved even more like a light beam. Each frequency "plateau" required new approaches to systems as well as hardware design.

Path Considerations

In many ways, the higher microwave frequencies behave just like the lower ones. The path-attenuation calculations, for example, are identical. For a given path, they show that a 12 GHz signal has 6 dB more path attenuation than a 6 GHz signal. On the other hand, the gain of a parabolic antenna of given size is 6 dB higher at 12 GHz. Since both the transmitting and receiving antennas are involved, the 12 GHz signal would appear to have a 6 dB advantage. In practice, however, this advantage is essentially canceled by higher receiver noise figures and higher waveguide losses at 12 GHz.

Selective fading at the higher frequencies can be effectively combatted by methods used at lower frequencies. Space diversity, for example, with its redundant transmission paths, substantially increases path reliability.

The effect of selective fading varies only slightly with frequency. For any given path reliability, the required fade margin in the 11 GHz band is at most a few dB greater than that needed at the lower frequencies.

Slightly less path clearance is required at the higher frequencies because the Fresnel-zone radii are smaller. Except in critical cases or on short hops, however, the difference is not likely to be very significant. For instance, on a 20 mile, 6.175 GHz hop, the first Fresnel-zone radius at 10 miles is 64.9 ft. If the frequency on the same hop is increased to 11.2 GHz, the radius decreases by only 16.8 ft.

Effects of Precipitation

Rain attenuates a microwave signal in two ways: the water absorbs energy, and the droplets scatter it. The severity of the attenuation is a function of the drop size, the temperature, the volume of water involved, and the signal frequency. The most significant part of this complex relationship can be summed up this way: the harder it rains, the bigger the drops, and the higher the frequency, the more severe the attenuation will be.

Of course, other forms of atmospheric moisture also affect signal attenuation, but rain is usually the dominant factor. Fog

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600-R SPECIFICATIONS:

- SSB, CW, AM and FSK superheterodyne receiver.
- Freq. Range: In addition to full coverage of 10, 15, 20, 40 and 80 meters, continuous coverage from 3 to 30 mc may be provided with an external oscillator, either tunable or crystal controlled.
- Ultra-smooth vernier tuning, with large knob and dial. The incomparable feel of the Swan tuning system.
- Sensitivity: ¼ microvolt at 50 ohms for 10 db signal plus noise-to-noise ratio.
- Selectivity: 2.7 Kc bandwidth with 1.7 shape factor is standard. Options include 0.5 Kc CW filter, 4 Kc AM filter, and SS-16 super selective filter.
- Crystal Calibrator with 25 and 100 kc selection.
- Hybrid Design: 7 tubes, 8 transistors, 12 diodes. Transistors used where they provide definite advantage. Tubes used where they still provide superior performance.
- Features Swan's exclusive Single Conversion design, with fewer spurious responses than multi-conversion designs.
- Fully compatible with 600-T transmitter, providing for transceive operation as well as separate frequency control. Also, CW sidetone, and genuine CW break-in operation.
- Built-in AC power supply.
- Dimensions:
  15 in. wide, 6½ in. high, 12 in deep.

$395*

600-T SPECIFICATIONS:

- Freq. Range: Full coverage of 10, 15, 20, 40 and 80 meters. Extended frequency coverage for MARS operation with plug-in crystal oscillator accessory, Model 510X.
- Power Rating: 600 watts P.E.P. input. 500 watts CW, 150 watts AM. 100 watts continuous AFSK.
- Pi-Network output for 50 or 75 ohm coax.
- Suppression: Carrier 60 db, unwanted sideband 50 db. Third order distortion approx. 30 db.
- Audio response: Plus or minus 3 db from 300 to 3000 cycles.
- CW Keying: Grid block circuit, Full Break-in system. Includes sidetone to receiver.
- VOX accessory, plug-in.
- Internal AC Power Supply.
- Dimensions:
  15 in. wide, 6½ in. high, 12 in. deep.

$495*

600-R ACCESSORIES:

Speaker in matching cabinet	**$18***
I.F. Noise Blanker. Installs internally	**$79***
Adjustable Audio Notcher. Installs internally	**$44***

*Factory price

and mist are essentially light rain. Attenuation due to hail is only a small fraction of that caused by rain. The effect of snow varies widely, depending on the moisture content, the flake size, and the temperature; but snow generally carries a much lower volume of water than rain does.

At the higher frequencies, heavy rain can be a real problem. The theoretical curves of Figs. 1 and 2 show how frequency would increase excess path loss if the rainfall rate were constant along the path. While actual rainfall rates are never uniform along the entire path, a hypothetical example based on Fig. 1 gives some feel for the effect of extremely heavy rain (4 in. per hour) on signals of different frequencies.

A 6 GHz signal, with an excess path loss due to rain of only about 1.2 dB per mile, would be attenuated by about 24 dB over a 20 mile hop. That is certainly significant, but it is within the operating capability of a system engineered with, say, a 40 dB fade margin.

A 13 GHz signal, on the other hand, would suffer rainfall attenuation of about 240 dB.

As shown in Fig. 2, a rainfall of 0.6 in. per hour would cause excess path loss of only about 1.1 dB per mile at 13 GHz – roughly the same as the 6 GHz signal would suffer at the much higher rainfall rate.

The trouble with curves such as these is that they fail to take into account the changing nature of heavy rain.

Local Rainfall Distribution

It is relatively easy to measure the effect of rain on a microwave path. The difficulty arises in trying to measure the rainfall rates along the path for accurate correlation with the attenuation measurements. The harder it rains, the more likely it is that the rainfall rate will show wide and almost instantaneous variations. Furthermore, there may be very heavy rain at one point, and almost none a short distance away.

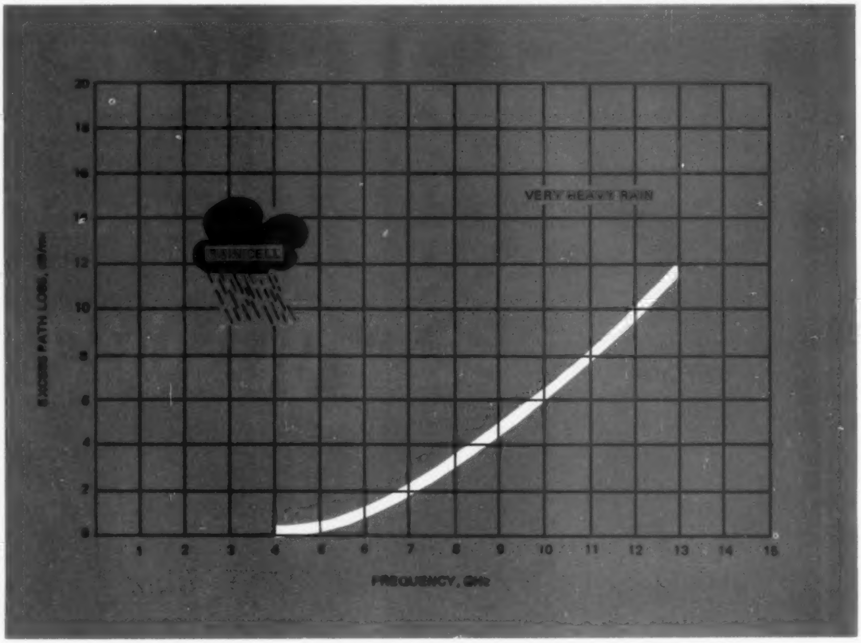

Fig. 1. Excess path loss caused by heavy rain increases rapidly with increasing frequency.

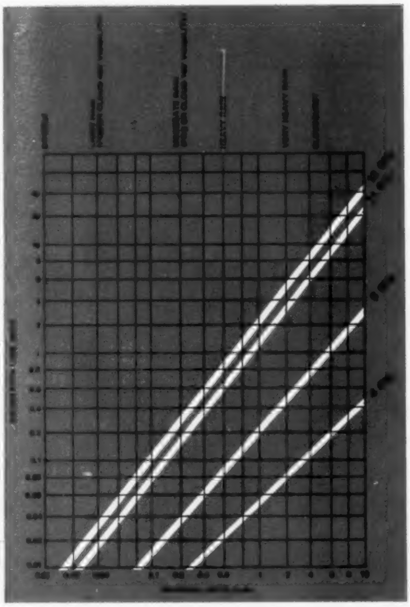

Fig. 2. Theorectical curves show how attenuation increases with rainfall rate (based on calculations by Ryde and Ryde).

The cumulative figures for the total length of a microwave path are often irrelevant.

Much work has been done in recent years on the nature of rainfall patterns. The results are not conclusive, but they indicate that the most intense rain, the rain that significantly affects microwave propagation, occurs in relatively small cells. Available evidence indicates that these cells rarely exceed a few miles in diameter, and the rainfall rate varies even within the cell.

This variation means that even an intense cell may not block a microwave path for the entire time it takes to cross the path. A five mile wide cell moving at 20 mph takes 15 minutes to cross a particular path at right angles. But it is unlikely to block the path completely for 15 minutes.

Rainfall Distribution

Paradoxically, some geographical regions known for their large annual rainfall (such as the rain forests of Oregon and Washington) do not present as difficult a transmission problem as do other "drier" areas. The reason is, of course, that the total annual rainfall is of little consequence. *Concentrated* rain causes the trouble. The significant questions are: How heavy are the rainfall rates that can be expected? How often can such rates be expected?

The problem in any area is complicated by the fact that although much information is available on *annual* rainfall, very little is known about *instantaneous* rates. Gradually, however, the body of knowledge has built up so that it is now possible to generalize about many geographical areas.

Figures 3 and 4, the results of empirical studies, indicate generally how expected outage time varies with geography in the United States. For example, an 11 GHz path, 30 miles long and engineered for a 40 dB fade margin, would have an expected outage time of about 0.2 hour per year on Washington's Olympic Peninsula (contour H). This translates to a reliability of 99.998%.

If the same path were located on the coast of the Carolinas (contour C), the predicted reliability would drop to 99.92% because the expected outage time would increase to 7 hours per year.

Now consider the same path on the Gulf Coast of Mississippi (contour A) and assume that the expected annual outage time must be held to the same 7 hours. The path would have to be shortened from 30 miles to 22 miles, or the fade margin would have to be increased substantially.

It must be remembered that these calculations are for a single hop. The outage time for the entire system can be expected to equal the sum of the single-hop outages. In terms of reliability, 10 hops with 99.99% reliability form a system that is only 99.9% reliable.

Diversity Arrangements

Heavy rain is not the only thing that will put a microwave system temporarily out of business. The mechanisms of selective fading are completely separate from those of rainfall attenuation. When the effects of rainfall attenuation cannot be completely controlled, one way to keep

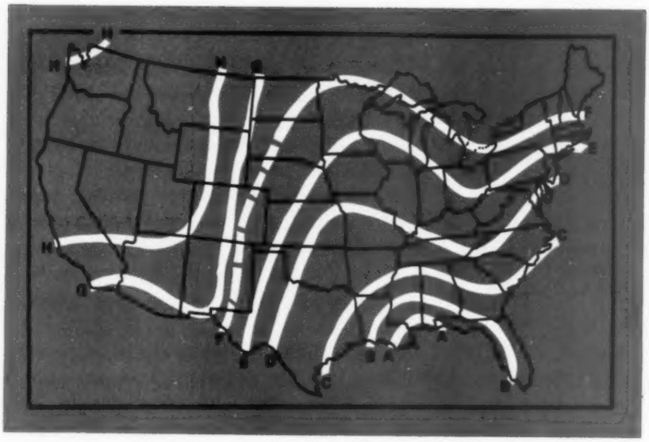

Fig. 3. The contours of this map are for fixed transmission outage time and can generally be used in conjunction with the curves of Fig. 4 to predict the effect of rainfall on path reliability.

reliability high is to pay special attention to selective fading.

Perhaps the ideal solution would be route diversity: sending the same signal over two paths separated by several miles. In practice, however, route diversity is too expensive to justify. Equipment and installation costs for communication links are quite high, not to mention the difficulty encountered at the receiving end in trying to combine the signals from two paths of substantially different length.

Conservative Engineering

There is no easy, clear-cut way to avoid problems with rain. The most effective defense is a combination of techniques. And conservative engineering is the first one. A marginally engineered system is an invitation to excess outage time.

One thing that can be done, for example, is to increase the fade margin. This does not guarantee transmission through the heaviest rain, but it does effectively lower the expected outage time.

Because of variations in the instantaneous rainfall rate, it is not always possible to specify exactly how much effect a higher fade margin will have on rainfall attenuation. But some idea can be gained from a hypothetical example like this: Suppose a particular 11 GHz microwave hop can withstand an average rainfall along the path of 1 in. per hour – an excess path loss of about 1.3 dB per mile. If the fade margin is then raised by 5 dB, the hop can still withstand the 1 in. per hour rain along the path, except for a two mile segment where it passes through a rain cell. In that segment, it can withstand excess path loss of 3.8 dB per mile – equivalent to a rainfall rate of over 2 in. per hour (see Gig. 6). In many areas, that much improvement will not eliminate rainfall outages. But it will reduce them.

Of course, increasing the fade margin may not always be desirable. If it means in increase in the number of hops, for instance, any gains in path reliability may be more than offset by the decrease in equipment reliability as more transmitters and receivers are added.

Equipment reliability is equally as important as path reliability. So is the reliability of the power source. And good maintenance is important, too. Improving the reliability of any one of these naturally improves the end product – total system reliability. Thus, economics is the common denominator in improving system reliability.

The higher frequencies which can provide bandwidths suitable for translators or multiple, individually controllable repeater links are unused, waiting to be tapped. They range in a continuous spectrum from

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the microwave frequencies through millimeter waves and infrared to the visible light region. Eventually, they may even include the ultraviolet range. The problem is finding a way to use them in practical communications systems.

Atmospheric Considerations

Since rainfall attenuation is one of the most significant problems in the 11 GHz band, and the effect increases with frequency, the problem can be expected to be even more severe at higher frequencies. Figure 7 shows theoretical rainfall attenuation as a function of rainfall rate for selected frequencies up to 40 GHz. (Some empirical studies have indicated even higher attenuation than predicted.)

While rainfall attenuation is still the most significant atmospheric problem, fog and mist become increasingly important at the higher frequencies. The deciding factor is the volume of water in the air, which is perhaps easiest to understand in terms of visibility. At 30 GHz, for example, fog that cuts visibility to 150 ft attenuates the signal by about 0.5 dB per mile. It takes more than twice the moisture concentration to reduce the visibility to 100 ft at which point attentuation is about 1.6 dB per mile.

In this frequency region, another phenomenon – molecular absorption of the radio energy – also becomes a problem. Water vapor (not to be confused with water droplets) absorbs more energy as frequency increases, with a significant absorption occurring at resonant peaks. One such peak is at 22.4 GHz. At this frequency, a relative humidity of 60% produces absorption of about 0.4 dB per mile. At 18 GHz, the same humidity absorbs energy at the rate of only about 0.05 dB per mile.

Another minor effect is the molecular absorption of oxygen, which also increases with frequency. The loss only becomes significant, however, at frequencies in the 50 GHz range.

Modulation Techniques

The frequency allocations for present-day microwave systems are intended primarily for equipment that uses low-deviation FM, with rf bandwidths of 20 MHz or less. This technique is well suited for voice traffic, which is usually multiplexed by frequency division. But, the nature of the traffic carried by microwave radio is being changed by two major factors. One is the tremendous increase in data communications, and the other is the increasing use of pulse-code modulation (PCM) for voice communications. The two are essentially the same from the microwave engineer's point of view. Either way, he is faced with the necessity to transmit pulses at a high rate. One method is to use digital microwave transmission. Such a system becomes one more step in the time-division multiplex scheme.

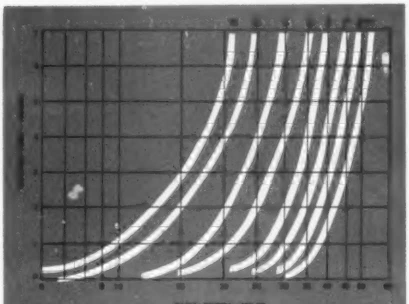

Fig. 4. Expected path degradation varies greatly with changing geographical rainfall distribution.

These curves, for use with the contour map of Fig. 3, are based on 11 GHz paths with 40 dB fade margins.

An advantage of PCM is its relative immunity to noise. Because it is only necessary to detect the presence or absence of a pulse in a particular time slot (not its height, shape, or any other characteristic), a PCM system can operate at a very low signal-to-noise ratio. Consequently, it is quite tolerant of the severe atmospheric attenuation.

Millimeter-Waves

The millimeter-wave region, from 30 to 300 GHz, is very attractive for wideband communications systems because of the tremendous bandwidth available. At these frequencies it is not at all unreasonable to think in terms of a 2 GHz baseband that

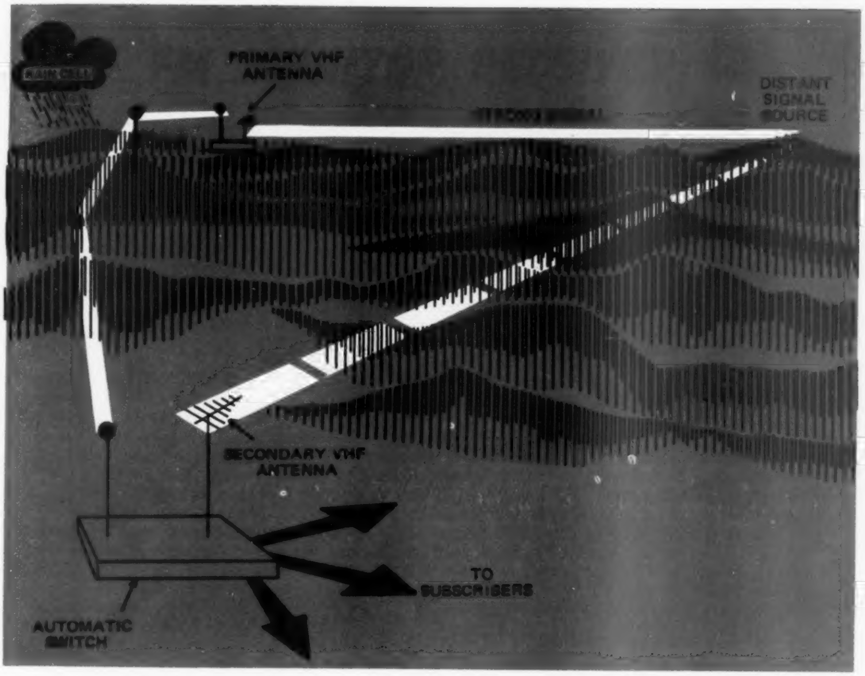

Fig. 5. Many CATV systems can use a secondary off-the-air antenna as a back-up for a microwave link.

could, in theory, accommodate over 200,000 voice channels – or the equivalent in other forms of communications.

Of course, the problems of atmospheric attenuation are exceptionally severe at these frequencies. In fact, transmission through the atmosphere may not be practical except for certain applications. One such case is satellite communications.

Laser Transmission

Few people have been more excited over the useful possibilities of lasers than have communications engineers. The reason for their excitement is quite simple: the information-carrying potential of any communications channel is proportional to its operating frequency. Because lasers operate in a frequency range about 100,000 times higher than today's microwave radio systems, they have the potential to carry 100,000 times more information.

But, potential is sometimes far from reality. While laser beams have been used to burn through steel in industrial applications, their penetration range is limited. They are still light beams, and light beams do not penetrate very far through heavy clouds and other atmospheric obstructions. For this reason, unprotected laser transmission is practical only for short distances or in space communications. Long-range laser communications systems will have to fllow an optically aligned tube. Here difficulties arise when the beam is bent – even enough to follow the curvature of the earth.

Therefore, any practical system will probably use a series of lenses to refocus the beam and change its direction slightly. In so doing, they will act somewhat as passive repeaters. Optical lenses can be used, but even the highest quality ones introduce substantial losses.

However, considerable promise is being shown by gas lenses. Such a lens can be formed by gas flowing through a heated tube. Because the gas is warmer near the tube wall and the cooler gas in the center is

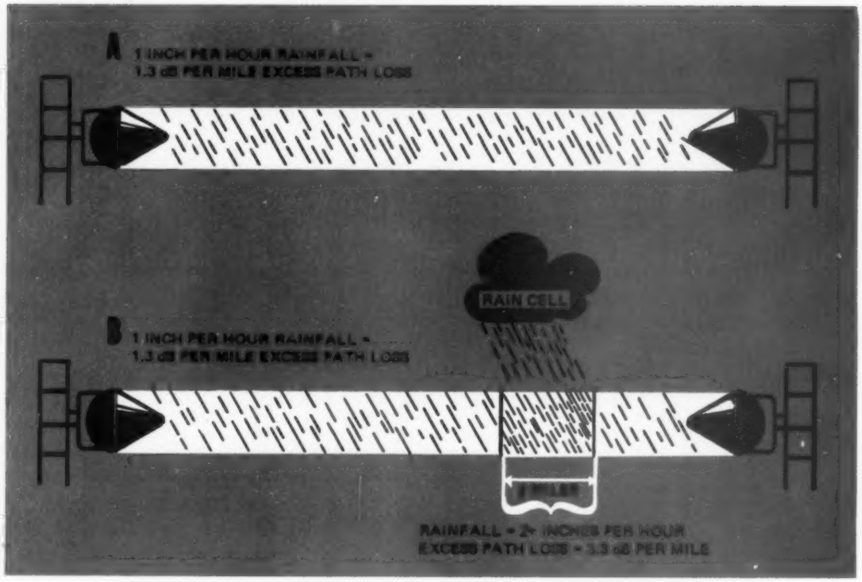
A
1 INCH PER HOUR RAINFALL =
1.3 dB PER MILE EXCESS PATH LOSS
RAIN CELL
B
1 INCH PER HOUR RAINFALL =
1.3 dB PER MILE EXCESS PATH LOSS
RAINFALL = 2+ INCHES PER HOUR
EXCESS PATH LOSS = 3.3 dB PER MILE

Fig. 6. Raising the fade margin by 5 dB, (as in B above) can permit transmission through a rain cell of substantially greater intensity.

denser, it acts as a lens causing the beam to converge. The advantage of this type of lens is that it places no solid surface in the path of the light beam. Therefore, the loss introduced by the lens is only that caused by the gas molecules scattering the light beam.

This principle sounds simple, but there are substantial obstacles to be overcome. A big problem is presented by the extremely critical mechanical tolerances required of a lens waveguide. The costs may make such an arrangement impractical.

Transmission is not the only area that presents problems for a laser communications system. Another hurdle is modulation and demodulation – and the associated area of multiplexing and demultiplexing.

One of the most promising modulation techniques is PCM – primarily because a laser can produce high pulse rates and very narrow pulses. If a laser beam is split as shown in Fig. 8, parts of it can be sent to parallel modulators to form similar trains of narrow, relatively widely spaced, pulses.

Fig. 7. Attenuation caused by rain can be a formidable problem at the higher microwave frequencies. These theoretical curves (after Ryde) should be used only as approximations. Some measurements have indicated substantially higher attenuation.

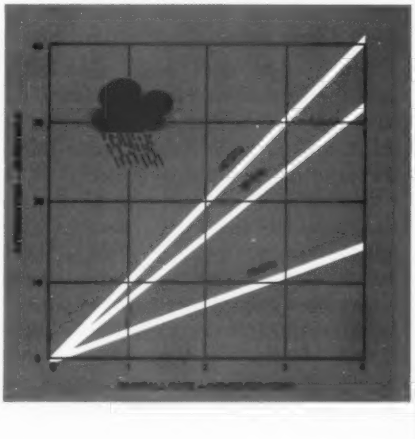

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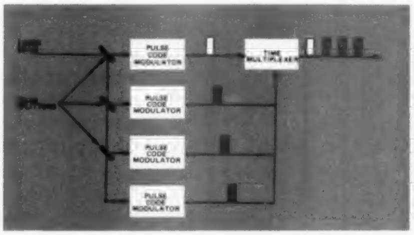
Fig. 8. PCM shows considerable promise for modulating lasers. The beam-splitting arrangement shown here forms several high-speed channels from a single laser beam.



These pulse trains can then be interleaved for time-division multiplexing.

It is theoretically possible to add more multiplexing steps. If, say, 100 time-multiplexed signals were frequency multiplexed, the capacity would increase 100-fold. It is then conceivable that still another form of multiplexing, called spatial multiplexing, could be used. This means sending a number of beams simultaneously through a waveguide in different propagation modes.

Such a system does not exist, and may never exist. However, a system has been suggested that would time-multiplex 32 channels in each of two polarization states, then frequency multiplex 100 of these "super channels," and finally use spatial multiplexing to combine 100 such beams.

The theoretical capacity of such a system staggers the imagination. The suggested bit rate would be about 2 x 10^{14} bits per second – the equivalent of 1,920,000 video signals.

The world has hardly begun to tap the potential of communications. It is not clear just what form the future uses of communication will take. But it is clear that man's capacity to devise communications systems has not been reached and the future is virtually unlimited.

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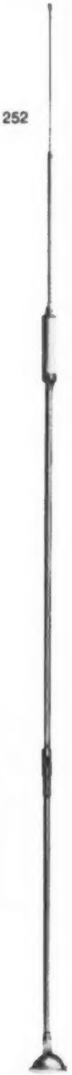
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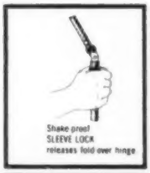
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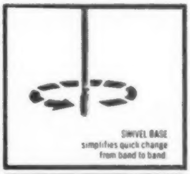
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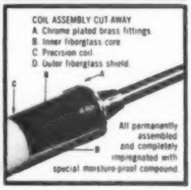
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CONSTRUCTION...of extra-heavy duty tapered swaged seamless aluminum tubing with full circumference, corrosion resistant compression clamps at slotted tubing joints...is so rugged and rigid that, although the antenna is 25′ in height, it can be mounted without guy wires, using a 12″ double grip mast bracket, with recessed coax connecter.

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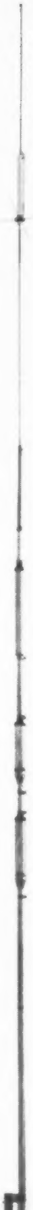

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Specifications: 90 day warranty

RECEIVER

The HR-2 receiver is a double conversion, superhetrodyne with highly selective ceramic filter.

Frequency Range	144-148 MHz
Sensitivity	0.35µv (nom.) 20DB Quieting
Selectivity	6DB Down ± 16KC 50DB Down ± 32KC
Audio Output (3-4 Ω Speaker)	3 Watts 10% Distortion 5 Watts Maximum
Channels	6 Crystal controlled with provision for adding an additional 6 channels
I.F. Frequencies	10.7 MHz & 455KHz

TRANSMITTER

The HR-2 transmitter uses phase modulation for the ultimate in carrier stability. Built in SWR load mismatch circuitry provides protection against open and shorted antenna conditions.

Frequency Range	144-148 MHz
Power Output	10 Watts (min.) @ 13.6 VDC
Modulation	Phase Modulation with automatic deviation limiting
Deviation	Automatic Limiting with internal adjustments from 0-15KC deviation
Microphone	Plug-in, hand held, high Z Ceramic supplied
Channels	6 Crystal controlled with individual trimmer capacitors for Frequency netting

GENERAL

Power Requirements	13.6 Volts (nominal)
Receive (Squelched)	180 MA.
Receive (Max. audio output)	800 MA.
Transmit	2.5 Amps (max.)

STANDARD EQUIPMENT

- Built-in 4" Speaker
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The reliability of most electromechanical repeater identifiers leaves something to be desired. In many cases an amateur repeater will operate as many as 500 times a day. According to a recent FCC ruling, each repeater must be identified at least every three minutes of operation. This means that the repeater may be identified just as many times as the repeater is operated. Most electromechanical devices such as relays, code-wheel devices, and tape decks cannot withstand the constant on/off operation of repeaters for any great length of time. Remember, those devices were for intermittent use – the code wheel for distress signals; the tape deck for listening pleasure, and so on. None of these devices were made to take the constant on/off use that is needed, let alone the environmental conditions.

One only has to climb to the mountaintop site after the first snow of the season because of an identifier failure to realize there ought to be a better way! Why not make the identifier solid state and eliminate those moving parts that wear out? Better still, why not use integrated circuits to accomplish the task? With a parts cost of less than $20, the Morse code digital identification unit (DIU) described herein does just that and it will outlast anything mechanical that you might otherwise put on top of a mountain.

The System

The DIU is unique in that it uses a simplified computer address principle for selecting the information it is programmed to send. There are four basic units in the DIU:

- Counter
- Matrix (memory)
- Signal logic
- Oscillator

The counter establishes which sequence is next. The matrix determines what instruction is next by the sequence. The signal logic converts the instruction information into the actual signal to be sent. The tone oscillator sends the requested signal. The whole system is based on a closed loop and therefore no standard clock is employed in the logic.

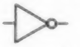
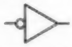
Logic Terms

To understand how the DIU works we must first become familiar with some of the simple logic terms that the system is based on.

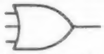
High: Maximum output of logic unit (at least +1.5V)

Low: Minimum output of logic unit (less than +0.5V)

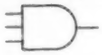
Inverter: Device used to produce opposite logic state of what is applied to it. Example: +2V into an inverter would produce a 0V output while a 0V input would produce a +2V output.

Symbol:  

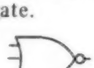
Or gate: Device used to give a high output when any of its input lines are high. Example: 3 input lines; one at +2V, the other two at 0V produces a +2V output on the output line of the gate.

Symbol: 

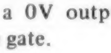
And gate: Device used to give a high output when *all* input lines are high. Example: 3 input lines; +2V on all 3 input lines of gate produces a +2V output on the output line of the gate.

Symbol: 

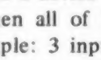
Nor gate: An inverted *or* gate; device used to give a low output when any of its input lines are high. Example: 3 input lines, one at +2V, the other two at 0V, produces a 0V output on the output line of the gate.

Symbol: 

Nand gate: An inverted *and* gate; device used to give a low output when *all* input lines are high. Example: 3 input lines, +2V on all 3 input lines of gate, produces a 0V output on the output line of the gate.

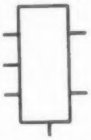
Symbol: 

For this article, *nor* gate logic was used to implement the *nand* functions; therefore, the definition for our purpose of a *nand* gate is a device used to give a high output when all of its input lines are low. Example: 3 input lines, 0V on all three input lines of a gate, produces +2V output on the output line of the gate.

Symbol: 

Note that the zero placed before or after the inverter, *nor*, and *nand* logic gates defines the expected state of the input or the output for the function to occur.

Flip-flop: A device used to store information a bit at a time. In the DIU application, a string of flip-flops is used as a counter. The purpose of the counter being to sequentially address the required instructions for the DIU.

Symbol: 

Unit: Smallest bit of information sent by the DIU (dih, dah, or blank).

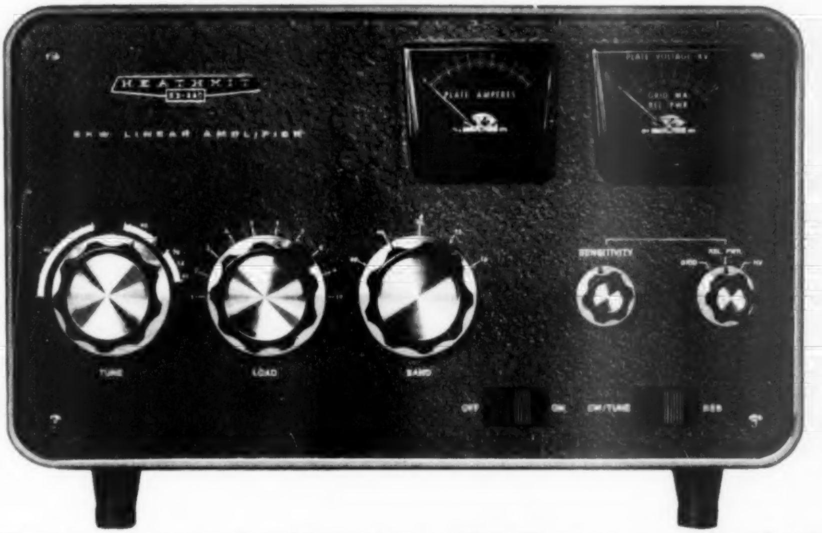
The DIU uses the MC700 series of Motorola integrated circuits due to their inexpensiveness and availability.

System Operation

A 0V signal through the start network (see Fig. 1) from the transmitter keying circuit resets all the flip-flops in the counter to the zero state. All Q' lines become high and all Q lines become low. Approximately 2V and 0V are fed into the diode matrix, which decodes the counter number into an instruction for the oscillator keying logic. In the DIU there are four basic instructions: (1) send a dit, (2) send a dah, (3) send neither dit nor dah (blank), and (4) stop.

If the diode matrix decodes the first sequence count (0) to be instruction number 1 (send dit), the dit signal line from the matrix will be high. This will cause the dit inverter to have a low output and one-half of the "dit enable" gate will be enabled. Since the space line is also at "low" level at this time, a trigger pulse will be sent through capacitor C7 to the "dit" one-shot. (A one-shot is a monostable device used to generate a predetermined pulsewidth.) The dit time pulse determined by the one-shot is sent through the "dit or dah" gate and the "dit or dah/blank" gate to enable the "dit or dah send" gate. The *nand* gate keys the oscillator circuit to produce the dit signal.

At the same time the dit is being sent by the one-shot to the oscillator, the "space" one-shot logic is being reset via the "dit, dah, or blank" gate, inverter, and "space enable" gate.



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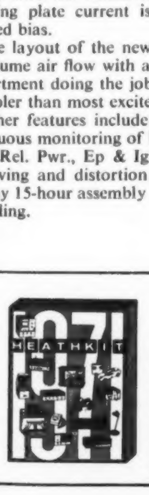

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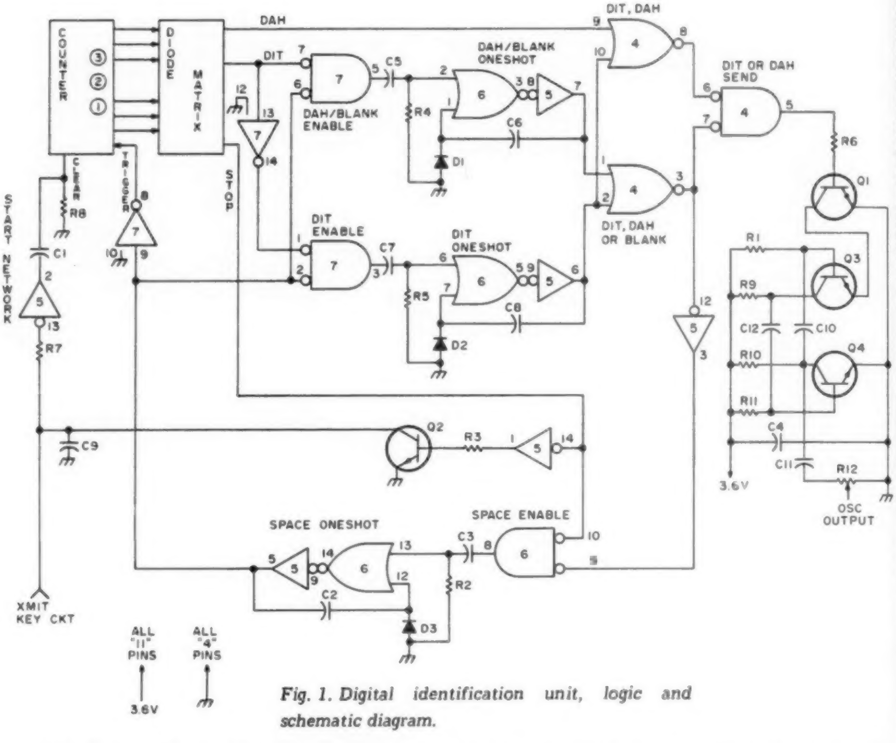

COUNTER
③
②
①
DIODE MATRIX
DAH
DIT
DAH/BLANK ENABLE
DAH/BLANK ONESHOT
DIT, DAH
DIT OR DAH SEND
DIT, DAH OR BLANK
DIT ENABLE
DIT ONESHOT
CLEAR
TRIGGER
STOP
START NETWORK
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
D1
D2
D3
Q1
Q2
Q3
Q4
3.6V
OSC OUTPUT
SPACE ONESHOT
SPACE ENABLE
XMIT KEY CKT
ALL "11" PINS
ALL "4" PINS
3.6V

Fig. 1. Digital identification unit, logic and schematic diagram.

Upon completion of the dit signal, the "dit, dah, or blank" gate becomes high, making the inverter output low. Since the stop instruction has not been called for by the matrix, the "sapce enable" gate produces a high output. The high output in turn sends a pulse through capacitor C3 to trigger the "space" one-shot. (The space time period is used to separate the units of a letter. Example: D = dah-space-dit-space-dit.

The space period is the same as the period for the dit. The space signal, besides allowing for the time to distinguish the units of a letter, advances the counter through an inverter to the next unit and resets the "dit" and "dah" one-shots by discharging capacitors C5 and C7.

If the diode matrix decodes the next sequence to be instruction 2 (send dah), the dah signal line from the matrix will become high and the dit signal line will become low. When the space line becomes low, the "dah/blank enable" gate will send a pulse through capacitor C5, triggering the "dah/blank" one-shot. The dah/blank pulse would then go through the "dit or dah/blank" gate while the dah signal from the matrix would go through the "dit or dah" gate. These two gates would then enable the "dit or dah send" gate to trigger the oscillator for the dash period. The "space" one-shot is again triggered to advance the counter to the next unit.

If the diode matrix decodes the next sequence to be instruction 3 (send a blank), neither the dah nor dit line will become high. The same will occur as above for the dah except that when the signal reaches the coincidence gates the "dit or dah" gate will not be enabled. Thus the oscillator will not be keyed. This generates the blank period which is put between letters. (Example: DE = dah-space-dit-space-dit-blank-dit-blank) Again the loop through the "space" one-shot is triggered and the counter is advanced to the next unit of information.

The counter is advanced each time a unit of information is sent until it is advanced to the "stop" instruction. This instruction causes a blank to be automatically sent and stops the "space enable" gate from triggering the space one-shot. The DIU remains in the stop state until a reset pulse is sent to the counter from the transmitter keying circuit and the whole process starts over again.

Of course the DIU works much faster than it can be described. Depending on the component values selected for C2, C6, and C8, the DIU can function at any reasonable speed. The particular values used in the prototype and listed for Fig. 1 (see Table I) causes the unit to identify at the rate of 42 wpm (2 seconds for DE W6FNO). If a faster or slower rate is desired, capacitor values should be changed accordingly. It should be noted, however, that C8 must be three times as large as C2 and C6 to give the proper character formation. This is a critical relationship and follows from the fact that a space and dit are identical in time length while a dah or blank is three times the length of a dit.

Table I. Parts list for DIU Logic Board and Diode Matrix

DIU Logic Parts	
R2-8	**10 K ¼W**
R9, R10	**3.3K ¼W**
	R1, R11r33K ¼W
C1, C3, C5, C7, C9	**.05 μfd disc 25V**
C10, C12	**.008 μfd disc 25V (1000 Hz)**
C2*, C1, C8*	**10 μfd/15V**
C4, C6*	**30 μfd/15V**
	***Most change in direct ratio**
IC1-3	**Motorola 791P**
IC4,6,7	**Motorola 724P**
IC5	**Motorola 789P**
Q1-4	**2M3415 or equivalent**
D1-3	**1N34 or equivalent**
IC sockets wire-wrap type	**Vector R-714**
22 pin PC socket	**Vector R-644**
Matrix Parts	
10-20 resistors	**3.2K ¼W**
60-100 diodes	**ge or si (all same type)**
22-pin PC socket	**Vector R-6⁄**

0 1 2 3 4 5 6 7 8 9 10 11 12 13
X — • • X • X X • — — X — •

14 15 16 17 18 19 20 21 22 23
• • • X • • — • X —

24 25 26 27 28 29
• X — — — Stop

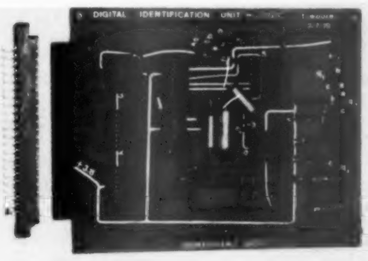
Fig. 2. Unit breakdown diagram.

Transistor Q2 is used to lock on the transmitter keying circuit while the digital identification unit is sending its identification code. If a timer is used in conjunction with the identifier, the transmitter will be keyed for the duration of the identification every time the DIU is reset. This allows a complete sending of the identification regardless of whether the transmitter remains keyed by an external circuit such as a COR (carrier-operated relay) or not. If this feature is not desired, Q2 should not be installed.

Transistor Q1 is used to key the oscillator, while Q3 and Q4 – along with the feedback and bias networks – make up the oscillator. The oscillator was designed to be fed directly to the grid of the modulator in the transmitter.

The Diode Matrix

Up until now very little has been said about the diode matrix other than the fact that it determines what instruction to give the keying logic. The actual construction of the matrix can be considerably simplified and consequently cheaper. Up to 70% of the diodes necessary for the diode matrix can be eliminated by using mathematics. A much more sophisticated, economical, and space-saving layout can be achieved using Boolean algebra. Thanks to Mr. Karnaugh, it is not necessary to give a complete discussion on Boolean algebra.



The IC logic board is shown here from the component side. Note the use of IC receptacles, which simplifies test, checkout, and replacement.

The Karnaugh map is a device for mechanically determining the mathematical equivalent of the diode matrix. For the purpose of this discussion the MCW message will be "DE W6FNO." Of course, any other message can be developed by this method and consequently this discussion may be used for developing any matrix logic.

The first step in determining the diode matrix for the message is to break up the message into the units to be sent: • = dit, – = dah, x = blank. This is shown in the breakdown diagram Fig. 2.

It is seen that 30 units of message will be sent (0 is actually used for a blank). To convert units 0 to 29 into a diode matrix, the Karnaugh map is used (see Fig. 3).

The numbers in the boxes correspond to the decimal equivalent to units on the output of the counter. The numbers across the top and along the side of the chart correspond to the binary output of the flip-flops – 1 for true or 0 for false. The letters written diagonally in the top left corner refer to the six flip-flops. Example: Box 17 has flip-flop A tue, B false, C false, D false, E true, and F false. Written in Boolean form, 17 would be represented by AB'C'D'EF', where the apostrophe after the letter indicates that the flip-flop is false and, conversely, a letter without an apostrophe is true.

To simplify the matrix, a Karnaugh map is constructed separately (Figs. 3 and 4) for the dits and dahs to be sent. From Fig. 2, units 2, 3, 5, 8, 13, 14, 15, 16, 18, 19, 21, and 24 represent the dits to be sent in the message. In the dit Karnaugh map (Fig. 4) a 1 is placed in each box corresponding to the number. An X (not the X which represents a blank) is placed in all boxes after the stop code number. These are "don't care" conditions because the counter will not count to these codes.

From the dit Karnaugh map (Fig. 5) it can be seen that the third unit of information is a dit and that flip-flop A is true, B is true, C is false, D is false, E is false, and F is false, or ABC'D'E'F'. To put this in matrix form, the Boolean algebra tells us that this dit would be represented by a diode connected to Q_a lead (the true lead of flip-flop A), another to Q_b, another to

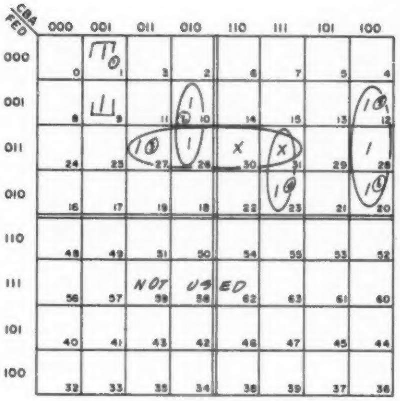


Fig. 3. Karnaugh map of dahs to be generated in DE W6FNO.

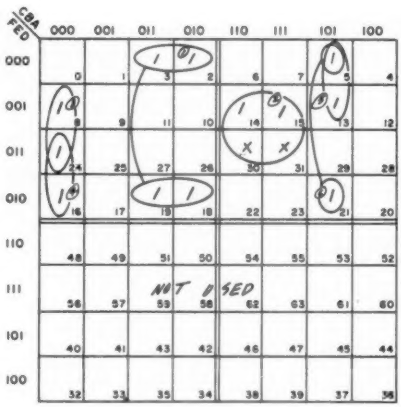


Fig. 4. Karnaugh map of dits to be generated in DE W6FNO.

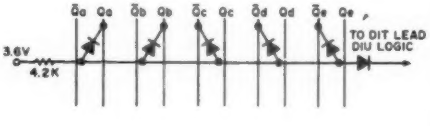

$\bar{Q}_a$ Q_a $\bar{Q}_b$ Q_b $\bar{Q}_c$ Q_c $\bar{Q}_d$ Q_d $\bar{Q}_e$ Q_e
3.6V
4.2K
TO DIT LEAD
DIU LOGIC

Fig. 5. Unit 3 information – dit.

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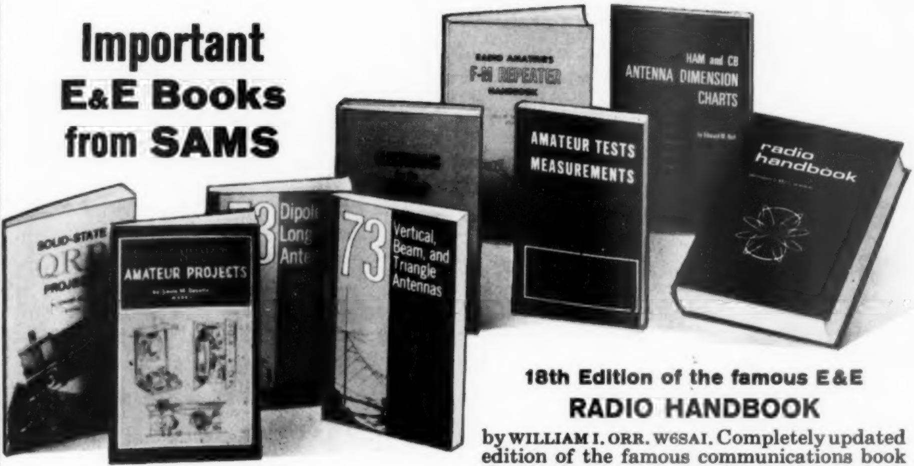
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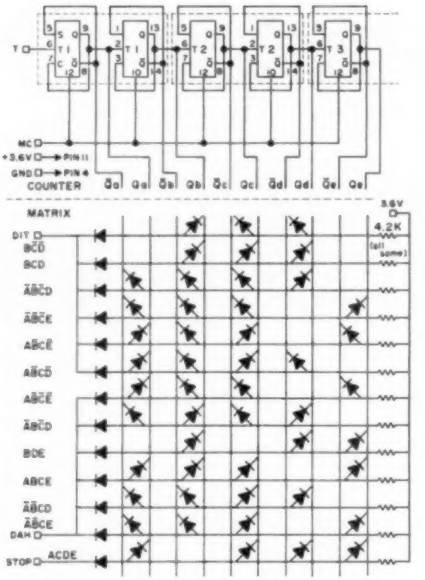

Fig. 6. DIU matrix and counter

Q_c' (the false lead of flip-flop C), another to Q_d', another to Q_e'. Since there are only 30 units of information, flip-flop F is not used. A line may be used over any of the symbols to indicate the same thing as an apostrophe. It would normally take six diodes (seven when the F flip-flop is used) to send this unit of information. See Fig. 6.

Actually, it would take six diodes (seven when the F flip-flop is used) for each unit of information in the message or 29 x 6 = 174 diodes. This includes the diodes needed to *or* the dahs together and the dits together. This is where the Karnaugh map saves diodes. Again on the amp in Fig. 4 any adjacent box or any box that changes just one variable from another box eliminated that variable. Boxes 8 and 24 simplify to A'B'C'D, eliminating the E flip-flop altogether. Boxes 3, 2, 19, and 18 also simplify since they change one variable at a time or BC'D'. Note that not only is 3 represented by BC'D' but also 2, 19, and 18, resulting in a savings of 20 diodes – 4 numbers x (5+1or) –(3+1or used) = 20. 14 and 15 combine with "don't cares" 30 and 31 to equal BCD. The final expression though not the only expression that will work) for the dits is BC'D' + BCD + A'B'C'D + A'B'C'E + AB'CE' + AB'CD'.

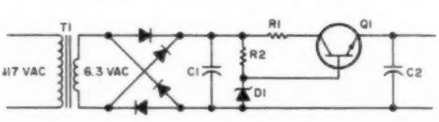

Fig. 7. DIU regulated power supply.

Figure 3 was used to develop the dah equation which is AB'C'E' + A'BC'D + BDE + ABCE + A'B'CD + A'B'CE. 28 diodes were used to develop the dit matrix, 29 were used for the dah matrix, and 5 were used for the stop code, giving a total of 62 diodes for the entire matrix. Quite a few less than 174!

The final matrix appears in Fig. 6 for the message DE W6FNO. Note that any matrix of this magnitude can be determined by the above method. To expand to 64 units of information the mirror image of the first 32 units is used in the Karnaugh map. In Figs. 3 and 4 the "not used" portion would be used. The upper portion of Fig. 6 illustrates the wiring of the counter; note that it mates to the leads of the matrix.

Construction of the DIU

Since the publication of the first article on the DIU numerous people have sought printed circuit boards for the unit. In order to obtain the DIU logic, matrix, or power supply boards, write to Keith Whitehurst, Box 538, Claremont, Calif. 91711.

This photo of the call letter matrix board shows the layout of the diodes for W6FNO. The same board is used for other calls, though the diode placement will vary.

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Regulated power supply module provides +3.6V to digital, identifies logic and matrix boards.

Table II. DIU Regulated Power Supply Parts List.

T_1	Stancor P6465 117 to 6.3V, 600 mA.
D_1	3.9V Zener 1N748 Motorola
D	1A 12V diodes or HEP Bridge
C_1	1000 μF at 12V
C_2	200 μF at 12V
R_1	10 Ω at 6.3V 5 Ω at 3.2V
R_2	220 Ω at 6.3V input, 110 Ω at 3.2V input*
Q_1	2N4921 or HEP 245

Power Supply

Figure 7 illustrates the schematic of the DIU power supply. Table II lists parts required. Any power supply, however, may be used if the power output is 3.6 V with less than 5% ripple (including voltage spikes).

Installation

The signals normally received and sent to and from the DIU should meet the following criteria:

1. From power supply – 3.6V dc, well filtered and regulated.
2. From transmitter keying circuit – 0V, transmitter keyed; approximately 6V transmitter unkeyed (filtered).
3. To transmitter keying circuit – identifier off: 10 MΩ; identifier keyed: 10Ω.
4. To modulator circuit – high impedance DIU oscillator output.

Note that all dc input lines to the DIU logic should be filtered. In some relay circuits the output of a bridge rectifier is used to directly key the transmitter relay. So the pulsating dc does not key the digital identification unit, a 60 μF capacitor (or greater) should be placed across the relay supply.

It is worthwhile to note that the original prototype, after two and a half years, is still operational atop Johnstone Peak in San Dimas, California, sending out for all to hear – DE W6FNO. . . . WB6BFM ■

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testing the NCX-1000

by Wayne Green W2NSD/1

After five years of making waves on the DX bands with a transceiver plus great big linear amplifier, it takes some getting used to, making virtually the same waves with a little box that I can lift with one arm . . . well, two arms . . . it weighs 59 pounds. And that includes the built-in power supply and loudspeaker.

The NCX-1000 is sure a far cry from the first National rig that I owned way back in the dim, dark past. The National 600 was a 600 watt transmitter first marketed back in the late 30's. I still use the indestructible power supplies and modulator from the 600 in my two meter kilowatt. The rf sections are, sadly, no longer state of the art.

Well, to get back to the 1000, National has come up with a real beauty in this rig. It is all solid state except for the final stages of the transmitter and it works like a dream.

Being a knob buff, a fellow that enjoys having dozens of knobs to twiddle, I was at first taken aback by the simplicity of the front panel of the 1000. Surely National must have left off some controls that I would need. If they did I still haven't missed them.

How does the 1000 compare with other rigs? Well, I stacked it up against three other transceivers on my operating desk, all working through a nice linear amplifier, and started making comparison checks all around the world, through poor conditions, monumental interference, and such. While there did turn out to be times when the extra power of the big rig surmounted pileups a little faster than the 1000, these times were satisfyingly few. Generally the report is that the 1000 is better copy

If I had been using different types of microphones it might account for the better voice reports, but I used identical mikes for the tests. The engineers at National have emphasized the higher range of the voice a bit more than the other rigs with the result that there is more punch and, other things being equal, the 1000 is more readable.

The NCX-1000 covers the amateur bands from 10–80 meters and provides sideband with either side, AM, and CW. The receiver works so well that I suspect that National must have borrowed more than considerably from their very successful HRO-500 receiver for the design.

They have a clever speech processor built into the transmitter (switched on from the front panel) which operates at rf. In this circuit the single sideband of the first i-f is clipped by a diode limiter and then filtered to remove the unwanted distortion products. This increases the average power by a factor of two, resulting in almost the same average power output as a two kilowatt PEP transmitter. My tests, by the way, were made with this clipper off when I was comparing the 1000 with other rigs. With the clipper on the signal is even louder, and though it loses a bit on voice quality reports it certainly gains on punch through pileups.

CW operators will appreciate the vernier control which displaces the receiver ± 3 kHz from the transmitter. This is also handy on sideband when the other op misses your frequency or drifts away from it during the contact. It can keep you from chasing someone with a displaced transmitter on down or up the band. An accessory vfo is available if you want to work split frequency more than 3 kHz. Hopefully, now that Gus is back in the U.S., little split frequency operation will be needed for a while.

It is strange that it has taken so long for solid state circuits to come to amateur sideband equipment. You don't find tubes in much new gear these days, except for amateurs. My car radio, FM receiver, television set, tape recorder, hi-fi, etc., are all solid state. Even the silly pencil sharpener is solid state! Out of one dozen 2m FM sets on the market, all are completely solid state except two....and both have one tube which will be superseded soon by an *all* solid state unit. Judging from the small size and light weight of the National 1000, solid state is certainly the way to go.

The 1000 covers all five amateur bands, 10–80 meters. An accessory 100 kHz oscillator plugs in for calibration of the tuning dial. The front panel meter functions as an S-meter on receive and reads plate current, screen current or plate voltage on transmit. AALC? Of course, and quite effective it is. The screen current meter function is excellent for rapid loading of the transmitter. I was able to tune it up in seconds . . . like the time I switched up from 80m to 20m and just happened to catch XT2AA (rare) calling CQ. Within three seconds I was tuned up and calling him. I made it.

The accessory 100 kHz calibrator also provides sidetone for CW operation. It can even be used for code practice, if needed! Obviously National has kept the CW ops in mind in the design of this rig . . . it covers all CW bands . . . and runs close to the legal limit to the 8122 final in this mode.

In all, the National 1000 seems to be well in keeping with the long history of excellent equipment that National has provided us down through the years. Many of us were concerned recently when their overdependence on government work forced them into bankruptcy. The company seems to be in pretty good shape now and is paying its bills, so perhaps they have weathered the depression.

. . .W2NSD/1■

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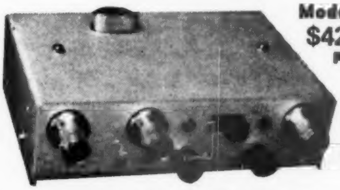

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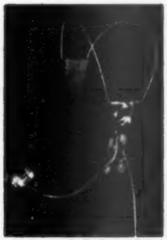

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All you have to do is look once at the price of commercial walkie-talkies to see how the effort of building your own can be justified. But there's a satisfaction that comes with operating something you've put together yourself, which goes well beyond the knowledge that you've beaten the manufacturers at their own game. I won't be foolish enough to tell you that building up a portable FM transceiver is a snap, because it frankly isn't quite that simple. But it really isn't particularly difficult either; and the time you spend will be amply rewarded by a good solid working knowledge of what's in those little radios you hold in your hand. Besides, it can be great fun!

The construction process is described here in its entirety – first, the receiver, then the transmitter. But since the project is to be a miniaturization job as well as simple construction, there are certain specifics involving components that must also be considered. In the main, these are dealt with individually.

Miniature Components

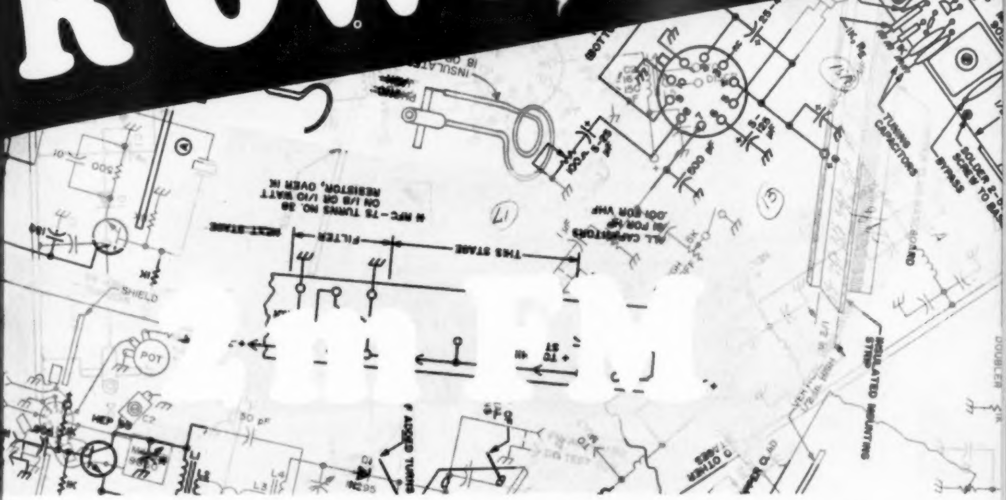
Capacitors. Bypass units can be the Lafayette thin units (see page 294 of 1970 catalog), where a 0.01 μF job can be found which is only 5/16 in. square by 5/64 in. thick. And the 1000 pF ones are only 11/64 in. square. For the lower values used in coupling and for fixed tuning capacitors, I like the Elmenco dipped silver-mica jobs.

Resistors. Resistors can be the Ohmite ¼ watters, but for the sake of miniaturization, you'll be better off if you get a selection of Allen Bradley 1/8 or 1/10 watt midgets. They're *really* small!

*Crystals.*The crystals should be the small plug-in kind, about 400 by 175 mils because repeater input channel frequencies do vary across the country. The most prevalent in the U.S. is 146.34, with 146.46 being Canada's prime choice. An absolute must for repeater use is the "Radio Amateur's FM Repeater Handbook," by Ken W. Sessions, Jr., which can be obtained (where else?) at 73.

Coils. The 8 and 24 MHz coils are the 9050 units from J. W. Miller, and are very handy for modifying to suit transistor input impedances, as well as having good, stable, mechanical tuning of the cores.

UR OWN!



There isn't much else on the strip that I can see except thin copper-clad, 1/16 in. linen-base Bakelite or fiber glass strips, four Motorola HEP 55s, and two Motorola HEP 75s (2N2866).

Various colors of subminiature wire will help also.

Special Tools

Don't worry about particular tools; they're not too special, as you will see, but you should prepare a little, in order to do a real good job. You must have the usual set of good small tools and it helps to thin down by grinding the already thin needle-nose pliers to get into those really narrow places you will find in back of the mounting strip. Use the same treatment on some small side-cutters also, because you will be cutting off a lot of small wires in even smaller places.

A collection of small low-cost screwdrivers will be handy, too – file them sharp and very small for special places. Sharp-pointed tweezers are handy as well.

For drills I go down to size 65 (35 mils) in a Black and Decker ¼ in. drill with the drill stand for under $10. Depending on how lucky you are, your drill chuck may not take those little drills. Some of them don't. Then you have to lay out another $3 or $4 for a jeweler's chuck, which will take a No. 80 drill (13½ mils).

You do not have to drill the component-lead holes exactly to size but the closer you do the more rigid the parts will be when mounted.

Various fiber TV tuning tools are useful for the trimmer capacitors, and several lengths of ¼ in. Lucite and Bakelite rods make good insulated screwdrivers also.

A slightly unusual aid I employ a lot is a "coffee stick" with an arrowhead-shaped lump of coil wax stuck on the end. When you're winding small coils with small wire it is very handy to put a drop of wax on the coil and let it sink in and cool. You can do this with the tip of your small iron, and it sure helps hold all that tiny wire in place. All the filter chokes shown use this method. Good for a lot of receiver coils to come later, too, and for holding the extra turns wound on the Miller coils for base impedance matching.

Be sure to have plenty of subminiature clip leads with flexible wire of various lengths from 1 in. up to 1 ft.

Have a good selection of Arco midget trimmers on hand also, such as the 400 series, which are just ½ in. long.

No. 48 or 49 bulbs are good for checking rf as you go along the multiplier chain from stage to stage. You should always be able to light one of these, which glow red (dull) at 20 mW. Use a matching series trimmer, as little as 5 pF for 147 MHz and less than 1 pF on 450.

Have a roll of plain masking tape to hold down strips and things while working on them. A small drill vise or the "third hand" bench vise helps, too.

Dos and Don'ts. These hints apply especially to a multiplier chain including a straight-through amplifier used as a phase modulator, which is the circuit being described in this article. It has an 8 MHz crystal oscillator and ends up on 147 MHz, so you must be *sure* of the frequency of each stage as it operates. Do *not*, rely on your receiver or on grid-dipping the inductors first.

These simple and inexpensive test accessories will help you in this work, as I found out – even after 50 years of radio endeavor. I tried rushing this multiplier along without using my homebrew set of absorption wavemeters (see Fig. 1) at every stage and trouble showed up right away.

Getting right down to the point, here is a list of handy items to have on the bench while you're building crystal oscillators, phase modulators, multipliers, and amplifiers. Using the absorption wavemeter, any circuit under test can be checked for the real and exact frequency at which it is resonating or oscillating, by lighting a bulb on rf or using a diode detector with a meter. When the absorption meter resonates with the rf in the collector circuit which is lighting the bulb or actuating the meter, a dip in the light or on the meter will show. This indicates the *real* frequency of the main body of the rf present. Some transistor collector circuits not tapped down on coils are especially notorious for this, and may exhibit two frequencies at the same time. For example, there may be energy at 72 and 96 MHz present. This is an indication of mistuning, or overloading, or both. Tap the collector down on the coil, don't load it so heavily to the next stage, check it carefully with the diode meter, and don't worry about a small remnant of off-frequency energy. After all, a multiplier is bound to have some of this present. Just get the *main* amount on frequency and be happy. And be sure the *next* stage also peaks on *its* desired frequency.

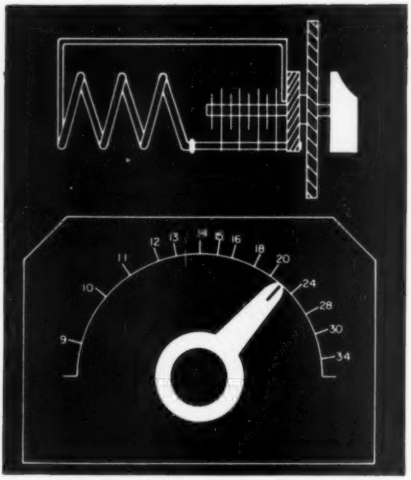


Fig. 1. Typical absorption wavemeter.

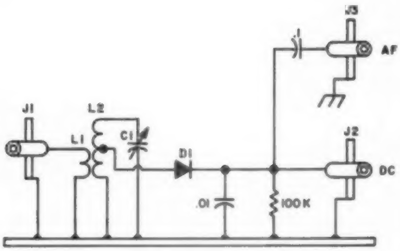


Fig. 2. Tuned diode detector.

A grid-dipper in the *diode* position can also be used for this work. A one-turn link around the low end of the grid-dipper coil and a cable will get you into small places in a rig where you cannot insert the whole dipper.

The diode detector. Figure 2 shows the schematic of one of these useful pieces of equipment which allow you to listen to your transmitter multiplier stage as you build it, and check the actual frequency at the same time. I have a collection of them

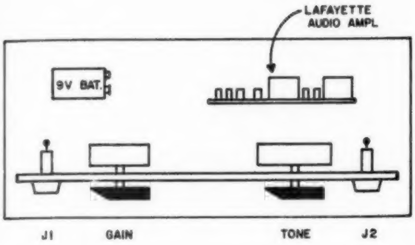


Fig. 3. Handy af assembly, top view

here covering from 125 KHz to 10 GHz. With a good variable capacitor you can generally run over three to one in frequency range – up to the UHF region at least. From there on up things get a little more difficult.

These "receivers," because that's what they really are, although of low sensitivity, are especially helpful in transferring known frequencies on a signal generator to a homemade set of wavemeters.

The meter. This should be as sensitive as possible. Lafayette has good ones down to 50 μA. Use a tap switch to put resistors in series to bring the voltage range up to 10V or so for use with an active portion of the rig such as the 1W final circuit.

The AF Amplifier. This item should not be neglected as it is at times a great aid to getting a trouble-free, *noiseless* carrier, which you can then modulate and be proud of. The valuable RCA handbook, "Transistors, Thyristors, and Diode Manual," has a lot to say about "discontinuous jumps in amplitude or frequency as various levels of drive are encountered." These little termites can be seen on the meter or *heard* on the af amplifier or can show up on both. Figure 3 shows a mounted version of the af amplifier used here for this purpose. It is a worthwhile and handy little piece of equipment to have in a lot of situations, in both receiver tests and transmitter tuneup. Just plug it into J3 of the diode detector in Fig. 2 and hear those unwanted clicks, whistles, rushing noises, squeals, etc., coming from what you may have wishfully thought was good clean rf in your multiplier drive!

Important notice! Overdrive is especially to be avoided in multiplier chains with transistors. Superregeneration is one of the indications. Believe me, it can be a very nasty bug!

Diode detector cable probes. Have a collection of these on hand as in Fig. 4. You can use them also to feed rf into a pilot light, connect up to your lab receiver, etc.

Handy meter jacks. Figure 5 shows an elementary but flexible and useful metering method for checking total or only one stage current.

FOUNDATION RECEIVER

The basic design shown here is for a low-cost single-conversion utility receiver for 2 meter FM; particular attention is given to easy-to-build i-f and discriminator modules for the 10.7 MHz section. The rf is tunable from 144 to 148 MHz, with a switch for AM use. This is a complete portable receiver, *not* tied down to a large ac communications receiver.

Discriminator action, with sample, is shown for easy understanding and homebrewing. Double conversion with crystal control can be added later.

The schematic of Fig. 6 shows how easy it can be. Remember, this is just a basic receiver which, without double-conversion, is a relatively broadband, easy-to-tune job, but it sure pulls in those interesting repeaters!

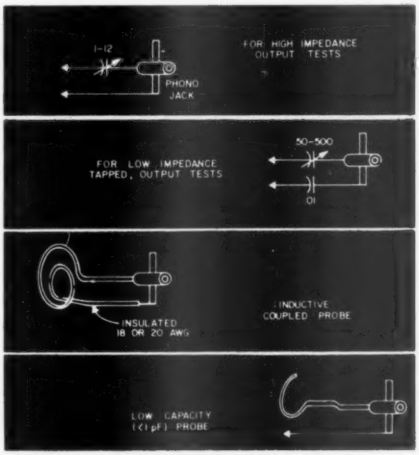

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Fig. 4. Coupling methods.

Front End

Simplicity is the word in this module. You can check different transistors for low noise, coils for rf, or add a low-noise stage; and the tunable oscillator is easy to change to a crystal oscillator for repeater operation. All three stages are tunable from 144 to 148 for coil, sensitivity, and selectivity experimentation, and to allow you to check the AM section of the band as well as repeater work in your neighborhood.

The oscillator tuning dial also relaxes preliminary oscillator crystal frequency requirements by allowing you to find out what crystals you will want later, and order them without rushing the deal. The link coupling at low impedance permits easy switching from tuned to crystal control, if you wish to retain the tunable feature.

The rf and mixer stages are tuned by small variable capacitors mounted on the baseboard with small brackets made from copper-clad. Small pointer knobs allow peaking of these circuits. The rf stage has a trimmer capacitor feeding the base which is quite useful, resulting in a welcome balance between gain and self-oscillation. The mixer also has a trimmer for its base input, which permits a selectivity adjustment for this circuit.

The tunable oscillator was mounted on the Miller slide-rule dial for mechanical stability as shown in Fig. 7, and works quite well – with the broadband i-f of course. As I write, the repeater band just below 147 MHz is giving out with various repeater-relayed calls, "W1AHE, anybody around?", K1SHE through W1ABI," "W1JLE through WA1KFY," "K6MVH through W1ALE," and various other calls, through such other repeaters as WA1KFZ, K1ZJH, K1MNS, etc.

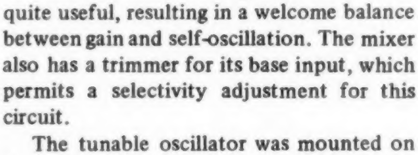
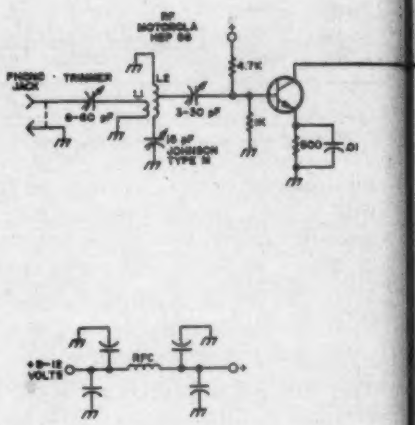


Fig. 5. Handy metering jacks and plugs.



The two-meter band can be spread out from 10 to 90 on the dial by trimming L7, increasing C5, and using a smaller C6.

Oscillator coupling can easily be adjusted for maximum conversion efficiency via L4 and L7, and the cable between them is a good place for the crystal–tunable switch mentioned above. To start up, adjust L7, C5, and C6 for the range 133 to 137.5 MHz as a local oscillator for the i-f of 10.7 MHz to be used later. I tuned up the whole front end using the diode detector of Fig. 2 tuned to 10.7 for the i-f section. When there is lots of 10.7 MHz energy out on L6, such as to deliver 5V dc out of the diode, you've got a good front end!

10.7 MHz I-F Stage

The reliable and sure-fire Motorola HEP 590 IC was used here – 25 dB gain, no

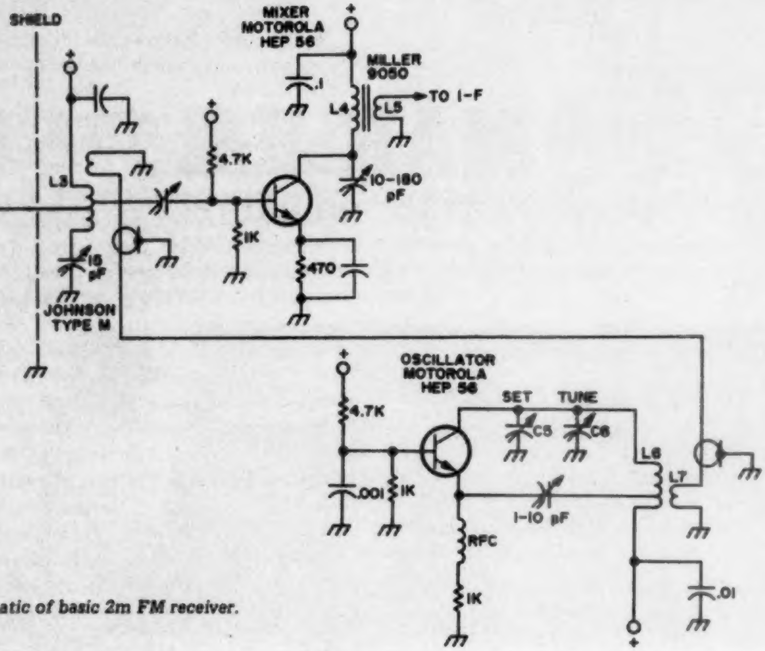

SHIELD
MIXER
MOTOROLA
HEP 56
MILLER
9050
.1
L4
L5
TO I-F
4.7K
10-180
pF
L3
IK
470
15
pF
JOHNSON
TYPE M
OSCILLATOR
MOTOROLA
HEP 56
4.7K
SET
TUNE
C5
C6
L6
L7
.001
IK
1-10 pF
RFC
IK
.01

Fig. 6. Schematic of basic 2m FM receiver.

self-oscillation, what else would you use? Figure 8 shows the circuit, using Miller half-inch shielded coils both on the input and output. Note that the 590 is simply turned leads-up and soldered onto a few resistor supports, with a shield, as in Fig. 9. A gain control is used, which may or may not be kept in later as you wish. With the limiters that can be added, the gain control is *not* needed.

A B+ filter is included in each module, and a 100Ω resistor with a 10 μF capacitor may be needed also to cut out motorboating when more stages are added later, if you go to double conversion. Be sure *not* to return L3 to *ground* dc-wise, as the needed bias is supplied internally through pin 4. Pin 9 is the main B+, along with the cold end of L3. Gain control can be obtained through a pot in the pin 5 lead, where maximum gain is reached with pin 5 at *ground* potential.

For new readers, the internal and external circuit of the Motorola IC 590 is shown in Fig. 10. This IC, which is very useful for frequencies up to at least 6 meters, has extremely interesting features, among which can be noted the absence of internal feedback (even at 50 MHz), the high gain, and the excellence of the gain control at pin 5, either manual or automatic. For this receiver, mainly intended for experimental FM use, no avc is used. Later, if you add double conversion, the limiter section module will eliminate the need for avc.

Trimmers are shown for C1 and C2, but fixed capacitors of the proper value may be used to allow tuning of the i-f coils at 10.7 MHz by the variable tuning slug cores in L2 and L3. Note that these Miller half-inch gems have very good electromagnetic as

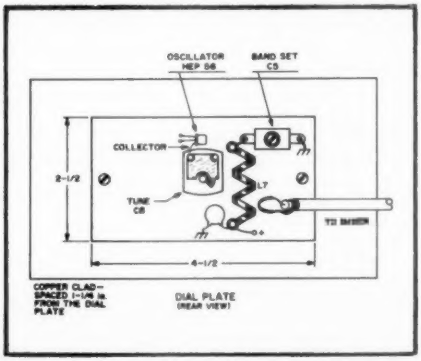

OSCILLATOR
HEP 56
BAND SET
C5
COLLECTOR
2-1/2
TUNE
C6
L7
TO MIXER
4-1/2
COPPER CLAD—
SPACED 1-1/4 in.
FROM THE DIAL
PLATE
DIAL PLATE
(REAR VIEW)

Fig. 7. Dial-mounted local oscillator

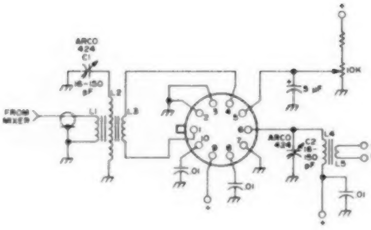


Fig. 8. 10.7 MHz i-f, bottom view of IC.

well as electrostatic shielding, due to the cup-core type of construction, and are available for use from 30 MHz down to 135 kHz.. They can also be easily opened for the addition of primary or secondary low-impedance windings.

Discriminator

After many days on the bench with discriminator circuits I at last hit on one that works like a charm for any frequency tried so far here – at least from 10.7 MHz down to about 135 kHz, and at the same time is easy for the homebrewer to build because of the link coupling. Figure 11 shows the circuit where L1 is a simple tuned coil in the collector circuit, with *no* coupling requirements other than a one- or two-turn link. When the primary of a discriminator transformer has to be coupled just right to the centertapped secondary it is not a job for the usual experimenter at his bench. With the link you can't go wrong. At least I haven't so far. Just tune L1 to 10.7 MHz, put a turn or two around it and another turn on L4 and away you go. Figure 12 shows the discriminator dc output curve, which handles about 25 kHz for 2-0-2V.

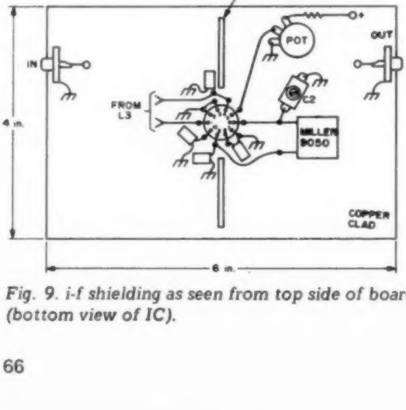


Fig. 9. i-f shielding as seen from top side of board (bottom view of IC).

I got the idea of using 10.7 MHz as an i-f (other than the fact that it is used for many years as the i-f for the FM broadcast sets) from some of the little $20 Nagasaki Hardware Co. sets used to pull in the police bands. It is also used a great deal in the two-way mobile sets, no doubt "because it was there" to begin with. It also can be used later as the first i-f, for narrowband work, by adding a 10.7 MHz converter to 455 kHz, and a 455 kHz i-f and discriminator. So, away we went, and I'm having a great time listening to those repeaters. However, please bear in mind that the i-f selectivity at 10.7 MHz is not sufficient for continued use on 2 meters, except to tune up the front end and to get acquainted with what's going on in your neighborhood, even though it is fun! It will also start you off on discriminator work, which I find has some very fascinating aspects, such as the extreme selectivity of the output curve for *one* tuned circuit. More later on this if time allows.

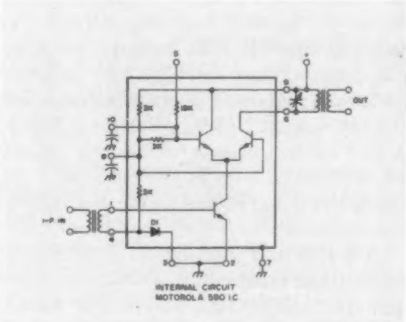


Fig. 10. Internal circuit of Motorola's HEP 590 IC.

Audio Amplification. Just for new readers we'll give a quickie on the Amperex TAA-300 1W "baby-hi-fi" IC which I now use for almost every audio purpose in receivers, and modulators up to a watt. There are about 11 transistors in that one little can, and it is flat to 1 dB from 25 Hz to 25 kHz! Get a halfway decent 8Ω speaker to go with it, because it's worth it. Figure 13 shows how to connect it up.

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P out—2W
@ 175 MHz
Sugg. Ham Net **$9.55**

S3006
P out—10W
@ 175 MHz
—$19.90

S3007
P out—25W
@ 175 MHz
—$24.95

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Sugg. Ham Net **$3.99**

S3001—This device features 5W power out @ 500 MHz. Will handle up to 65 Volts and 1 Ampere for use in portable and Low-Power Driver and output stages.

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Sugg. Ham Net **82¢**

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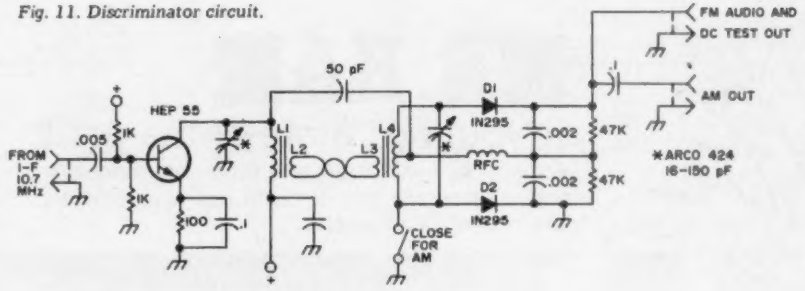


Fig. 11. Discriminator circuit.

FROM
I-F
10.7
MHz
.005
IK
IK
HEP 55
100
.1
+
50 pF
L1
L2
L3
L4
D1
IN295
D2
IN295
RFC
.002
.002
47K
47K
CLOSE
FOR
AM
.1
FM AUDIO AND
DC TEST OUT
AM OUT
*ARCO 424
16-150 pF

FM TRANSMITTER STRIP

The transmitter section measures 1 in. wide by 8 in. long, and it puts out over a watt on 146–147 MHz, with low-cost components. This miniaturized transmitter is my logical step toward design and ultimate construction of a "shirt pocket" portable transceiver. The parts for that one jump up a little in cost, because it takes a lot more tools to make subminiatures, such as stereo microscopes, special materials and skills, jewelers tools, and so on.

Shape Factor, and Assembly Method.

These are important features, as you will see, allowing the homebrewer to build a complete FM rig in a minibox and still have room enough left over to change components for repairs or design improvements if needed. You can also substitute slightly different components if you have to.

Figure 14 shows the method, using a copper-clad baseboard on which is mounted a drilled ½-in.-high strip of insulating material holding all the components. Bypass capacitor leads to ground are no longer than ¼ in., shielded coils are used, and all tuning is done from one side.

The photos show the happy results of placing the parts to best advantage on such an assembly. Notice that the components are also all on one side, and their leads and connections are on the other side. On the wiring side, every connection is spread out in front of you, with room between each one for good soldering; no resistor supports or other metal tie points are needed.

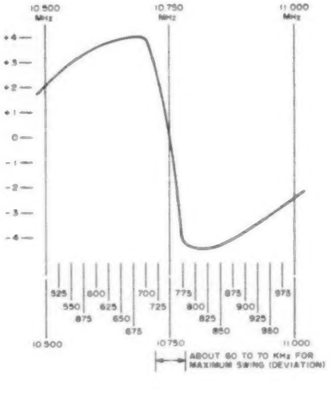
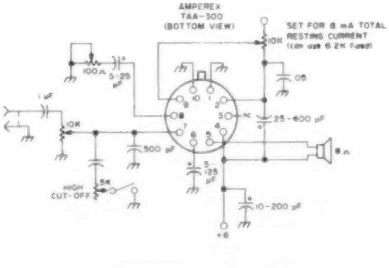


Fig. 12. Discriminator dc output curve.

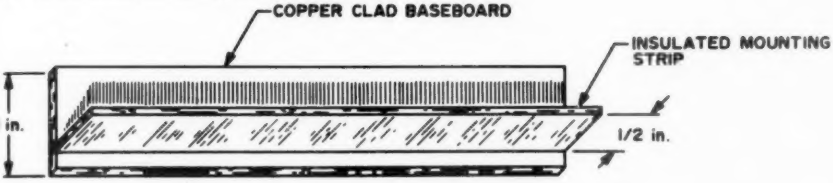
The B+ lead is red subminiature wire and goes from filter to filter along the strip. The rf lead is green and goes from the coil output tap of each stage to the next base coupling capacitor; the rest of the connections practically fall in place for soldering together. As you can see, there is still room left over!



AMPEREX
TAA-300
(BOTTOM VIEW)
SET FOR 8 mA TOTAL RESTING CURRENT (can use 6.2K fixed)
10K
.05
25-400 µF
1 µF
10K
100Ω
5-25 µF
500 pF
5K
HIGH CUT-OFF
5-125 µF
10-200 µF
+6
8Ω
1
2
3
4
5
6
7
8
9
10
NC

Fig. 13. Audio amplifier IC.

Fig. 14. Baseboard/mounting strip configuration.


COPPER CLAD BASEBOARD
INSULATED MOUNTING STRIP
1 in.
1/2 in.

The detailed planning of the holes to be drilled becomes a large portion of the work. Figure 15, component side and top views, shows how to start this off. The next step is to make a life-size drilling template using the components you have or intend to use. I mention this because most of these are not critical and you may substitute without trouble providing you keep thinking "little." Even here, you can go bigger with the components if you want to, but your overall package size may expand. You can also go smaller if you plan carefully and cram everything together a little tighter. The reason for this will be evident if you study the circuit, where you will see that no critical wires cross over each other, and that the power amplifier is well away from the oscillator.

Ultimate size is actually up to you, and you can judge for yourself after laying out the parts on hand. If you send for a selection of Lafayette Radio very thin and small capacitors, you will have an easier task to get it down in size.

Figure 16 shows two methods of preliminary fastening of the vertical strip to the copper-clad baseboard. This will start off the assembly, and after the wiring you could hardly tear them apart with your fingers. I counted no less than 25 ground connections to the copper on my own 10 in. strip.

You can also make strip modules of any length you want such as modulator af, receiver sections, etc., as shown in the receiver plans. This makes the task of repairs or improvement changes easier later on. These shorter strips can be fastened end on to each other and fastened down to the baseboard as shown.

Miniature Filters.

Do *not* try to make up frequency multipliers *without* rf filters in the dc line to each stage, unless you care to experiment with rf phasing in battery leads – and that isn't good! (Every time I leave out the filters I get into trouble!) You can make up

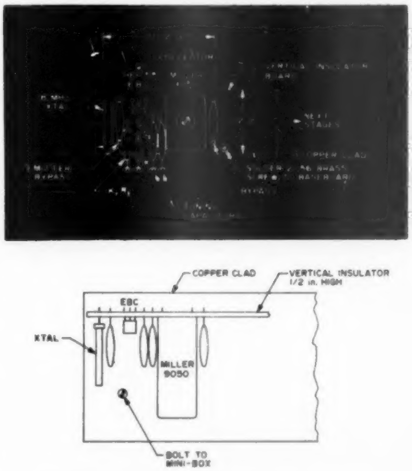

NEXT STAGES
COPPER CLAD
COPPER CLAD
VERTICAL INSULATOR
1/2 in. HIGH
EBC
XTAL
MILLER
9050
BOLT TO
MINI-BOX

Fig. 15. Component layout, top and side.

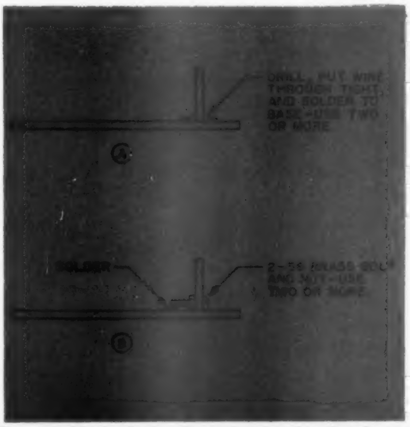
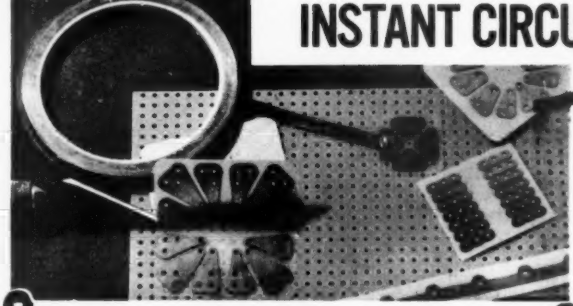

DRILL, PUT WIRE THROUGH TIGHT, AND SOLDER TO BASE–USE TWO OR MORE
A
SOLDER
2-56 BRASS BOLT AND NUT–USE TWO OR MORE
B

Fig. 16. Methods for fastening insulated strips to baseboard.

"dime" filters without much difficulty if you follow the simple details below. Materials needed are tiny resistors (any value over 1kΩ), some 36 or 38 AWG wire (double silk covered), coil wax (you can use paraffin wax if you can't get coil wax), and small capacitors, such as the Lafayette types. Use 0.01 for HF and 0.001 (1000 pF) for VHF. Figure 17 shows the circuit. The main thing is to interpose an rf trap in the plus lead between each stage and any other.

The series method shown in Fig. 17 is best for high-gain amplifiers because it puts *several* filters between the high-power output stage and the sensitive first stage. However, if the filters are very good you can bring the battery leads from each stage to a common point, but this must be checked carefully if you have to do it.



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How to make'em. Clean and tin carefully each resistor form lead close to the body, then melt a thin layer of wax onto the resistor to hold the wire from slipping when you wind it on. Solder one end of the wire onto one lead and then random wind 75 to 100 turns of 38-gage wire onto it, and wrap the end around the other lead ready to solder. Put a drop of wax on the coil before soldering to hold the wire turns in place. The wax should penetrate the whole coil. Most types of insulation on

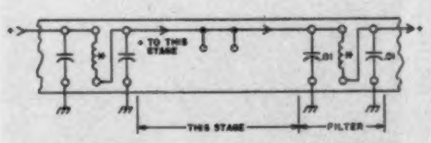

Fig. 17. Miniature filters, interstage.

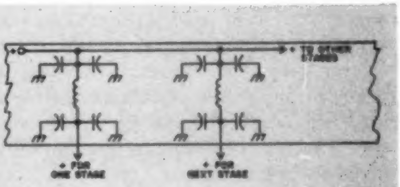

Fig. 18. UHF filters for interstage coupling.

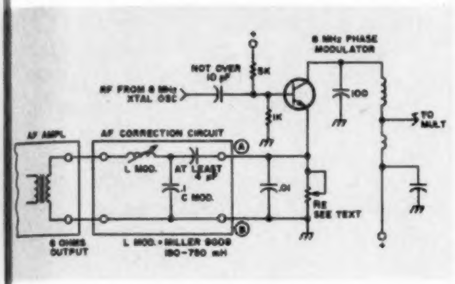

Fig. 19. Phase modulator interconnect circuitry.

38-gage wire will disappear as soon as solder and heat are applied, so you don't have to bare the wire first. Now you have an rf choke, and if you keep the capacitor leads real short to ground, the filter will do the job for you.

It works fine even up to 450 MHz if you use four capacitors, each to different point on the ground plane of copper-clad, as in Fig. 18.

Phase Modulator

Phase modulation results in a type of frequency modulation of the carrier at the rf output jack which the usual FM receiver cannot distinguish from true FM. Being crystal-controlled it is used by practically all the FM mobile and base stations in the U.S. so it is 100% okay here. And of course with the crystals in there, you *will* be on the amateur FM channels, providing you buy them right. You have to pay around $7 for these but it seems well worth it.

Certain designs of the af section of the phase modulator, its tuneup, and the connections to the phase modulator can be troublesome for the homebrewer, so considerable time was spent to make it as simplified and easy to adjust as possible. It also can be used in the receiver section as the af amplifier because the frequency correction is done *outside*. The use of an 8 or 16Ω output connection into the phase modulator emitter circuit helps to stiffen the af drive and keep it clean.

Phase modulation af sections in commercial rigs are often qualified as "audio conditioning," or "processing" circuits, which they are of course, but don't let that bother you. Excellent FM quality can be obtained by the use of an inductance of large value, placed outside of the af amplifier, in the noncritical low-impedance output circuit. The inductance cuts down the extra high audio modulating frequencies caused by the phase modulator's tendency to make the FM deviation directly proportional to the modulating frequency, which emphasizes the highs too much unless corrected. Being outside of the af amplifier, you can now use almost any good low-cost job and use it in the receiver also.

Figure 19 shows the simplicity of the method used. Having a four-transistor amplifer from Lafayette, at $4.95 on hand, that's what was installed, with a slight adjustment of the feedback resistor. This had nothing to do with the FM unit, it just happened that the Lafayette amplifier sounded and acted awful funny at first. And no wonder –, it was oscillating up in the 100 kHz range! After trying to bypass and decouple almost everything in the little brat my eyes began to focus on that printed lead going from the 8Ω output connection over to near the input, and sure enough that was it: too much feedback! An additional 50 kΩ resistor in series with the one already there did the trick and from then on nothing but good af came out. I mention this because it could happen to you too. My 3W job, also Lafayette, is suspect, possibly the same simple trouble.

The af output needed to drive the phase modulator emitter is several hundred millivolts, and the low impedance allows the usual rf bypass capacitor of 10,000 pF to act simply as an additional af filter, which it does.

As a result, the entire tuneup is done by adjusting the value of the emitter resistor and the phase modulator tank tuning coil. Neither are actually critical but should be

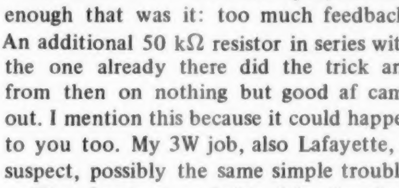

Fig. 20. Drilling layout (wiring side).

adjusted while listening to the 146 MHz carrier on a good amateur narrowband FM receiver. The emitter resistor will be heard to kill the modulation when going much below 2 kΩ and to bring in distortion on large amounts of audio when going a lot more than 2kΩ. This latter condition also causes a drop in the rf output. You may hit it right the first time with the 2kΩ value; I'm just pointing out that this resistor is worth checking up on for a final value when adjusting for best modulation.

The actual phase modulation resulting from varying the emitter voltage with audio is adjusted by tuning, which is also smooth and noncritical. I used the tried-and-true method of listening to my own voice with plenty of audio on the receiver and a set of well-padded earphones (you can get a very useful set for under $10 at Lafayette) which keep your voice from reaching your ears directly through the air. It also cuts down audio feedback.

Tuning with af going into the phase modulator as per Fig. 19, you will notice good strong clean FM on either side of the peak tuning. These points occur *before* the 146 MHz carrier output starts to drop from detuning the phase modulator tank, so don't worry about that part. In any case, you are supposed to be following the phase modulator with enough saturated class C multipliers and amplifiers to prevent any variation in amplitude (otherwise known as AM!) I say "supposed to" because you don't automatically get this condition. You may have noticed an unduly large number of tubes showing in ads for surplus commercial FM sets. This large number is due to the designer's wish to get *all* the benefits of FM into his package. In one box if possible. You have to watch *very* carefully when using ICs for modulators, they tend to pick up rf and generate feedback with their wideband audio circuits and sometimes as many as 11 or even more transistors in one little can. Just a word of what to look out for. It's hit me more than once. Also, don't put more than the specified voltage on IC amps. You can easily drop down with a resistor and a *large* bypass capacitor.

I used my favorite mike on the input, the Astatic 150, my favorite because it only weighs 3 oz, has the most output, −44 dB, costs only $3.82 amateur net, and sounds good!

Almost any desired amount of highs and lows can be obtained or surpressed by the manipulation of the LC values in the modulator. If you use a Miller .9009 wide-range adjustable inductor, 180–750 mH you can hear the difference as you adjust the core in and out.

I started out with a large-scale layout for the parts, but you may wish to skip that and go right to a life-size layout as in Fig. 20. To make the life-size drilling template, lay out the components one after the other, "standing up" on a ½ in. strip of good-grade white cardboard and mark the component lead holes, which should result in something similar to Fig. 20. A nice feature of the cardboard method is the easy punching of the holes and the way it holds the drill as you go through the strip. Tape the template in place onto the insulating vertical strip. Do not use anything that melts under heat, though. Even if you ruin part of the strip, or want to make a large change of one stage you can just saw that out and make up another section and go ahead.

The 8 MHz Oscillator

Figure 21 shows the schematic of the crystal oscillator stage. Note the apparent use of negative feedback with the base return through the crystal to a tap on the inductance. It is only apparent though, as the crystal reverses the feedback phase, making it positive. It is a very powerful, sure-fire circuit.

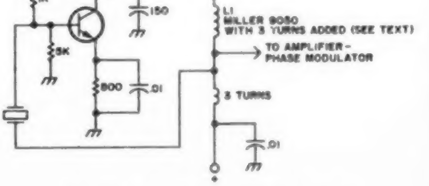

Fig. 21. 8 MHz oscillator schematic.

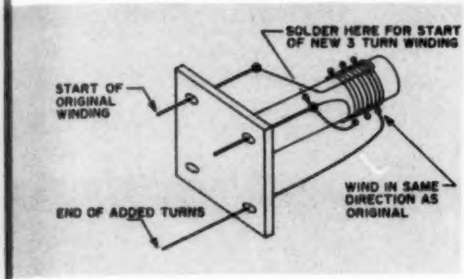
SOLDER HERE FOR START OF NEW 3 TURN WINDING
START OF ORIGINAL WINDING
WIND IN SAME DIRECTION AS ORIGINAL
END OF ADDED TURNS

Fig. 22. Miller 9050 coil with added turns.

The tap on the coil also provides a good low-impedance match for the next base input. The coil itself is made from a Miller 9050 shielded coil which has magnetic as well as electrostatic shielding, and a good adjustable core that works good mechanically (which is more than you can say for some of those types of cores).

Remove the aluminum can by bending back the four holding tabs and wind on three turns of 30- or 32-gage silk-covered wire onto the existing winding of the coil. Be sure and wind them in the same direction as the turns that are already there. The oscillator coil will then look like Fig. 22, and is ready to mount on the strip.

The wiring on the lead side of the strip is shown in Fig. 23, where most of the leads are seen to fall in place quite well.

Insert the component leads through the strip and bend them slightly in the direction they will go, such as the two base resistor leads which are bent towards the base lead, as shown clearly in Fig. 23. When all the leads to be soldered in one place are all touching each other, a final dressing can be done followed by soldering. In the example mentioned, the base lead has three other wires soldered to it, a wire from the crystal, the 1 kΩ resistor, and the 5 kΩ resistor.

The can of the 9050 coil has a tab which should be soldered to ground. The ground lead of some resistors (or all of them) is not routed through the strip but is soldered to the baseboard on the component side of the strip.

When the oscillator is assembled and wired, B+ can be brought in and the unit tested for rf. Some 5–10 mA of current

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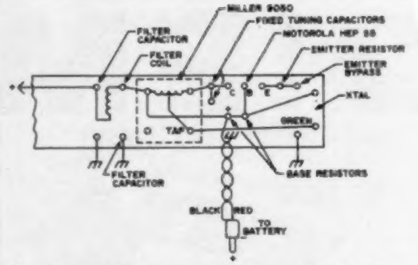

MILLER 9050
FIXED TUNING CAPACITORS
MOTOROLA HEP 55
EMITTER RESISTOR
EMITTER BYPASS
FILTER CAPACITOR
FILTER COIL
XTAL
C
B
E
O
TAP
GREEN
BASE RESISTORS
FILTER CAPACITOR
BLACK
RED
TO BATTERY

Fig. 23. Oscillator wiring diagram (lead side of strip).

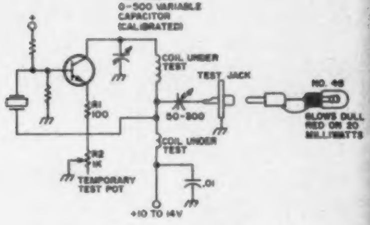

TEMPORARY 0-500 VARIABLE CAPACITOR (CALIBRATED)
COIL UNDER TEST
TEST JACK
NO. 48
R1 100
50-300
GLOWS DULL RED OR 20 MILLIWATTS
COIL UNDER TEST
R2 1K
TEMPORARY TEST POT
.01
+10 TO 14V

Fig. 24. Oscillator test setup.

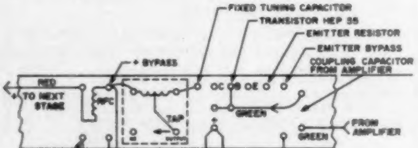

FIXED TUNING CAPACITOR
TRANSISTOR HEP 55
EMITTER RESISTOR
EMITTER BYPASS
+ BYPASS
COUPLING CAPACITOR FROM AMPLIFIER
RED
+ TO NEXT STAGE
RFC
OC
OB
OE
GREEN
TAP
FROM AMPLIFIER
GREEN
RED
RED
FILTER CAPACITOR
+ FROM AMPLIFIER

Fig. 27. Wiring diagram, 8 MHz tripler.

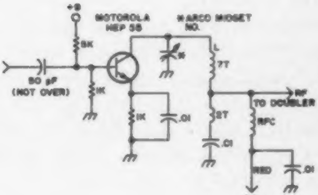

+B
MOTOROLA HEP 55
ARCO MIDGET NO.
5K
L
7T
50 pF (NOT OVER)
1K
RF TO DOUBLER
1K
.01
2T
RFC
.01
RED
.01
TO DOUBLER

Fig. 28. 24 MHz tripler schematic.

should register and as soon as the oscillator coil is resonated to the crystal frequency, the oscillator should show rf output to the 8 MHz tuned diode test set connected to the output tap lead.

Check the oscillator carefully on a sharp receiver for its frequency-holding ability while tuning the slug in and out of resonance at 8 MHz. Actually this will be near 8.130 MHz. (With a multiplication of X18, this should land on whatever 2 meter FM channel you're aiming for). It should come into resonance on one side with a good "plop" and gradually build up on the other side as you tune.

I always start with a large calibrated variable capacity at C3 (some 500 or 1000 pF, made from an old BC set three-ganger) and then put in fixed values so that the iron core tuning slug in the 9050 coil tunes properly about ½ in. under the winding of the coil.

Power can be adjusted by the emitter resistor, and feedback by the number of turns between ground and the oscillator-coil tap. (These are of course the number of turns added to the Miller 9050.)

A 48 or 49 bulb, rated at 2V and 60mA, should light up with about 50 to 100 mW worth of rf with a 50–300 pF trimmer in series, as in Fig. 24. When the oscillator is properly tuned and under good power control via the test pot (in Fig. 24) and the plus voltage is checked for the voltages you expect to see, the next stage can be assembled. Of course if you wish, you can mark out the whole strip template, drill all the holes, and mount and solder all components except the coupling capacitor and B+ to the next stage. This allows you to test the oscillator by itself.

The 8 MHz Amplifier–Phase Modulator

This stage (Fig. 25) is not critical, other than to keep the input base coupling capacitor at a low value to avoid self-oscillation. The only requirement is that the tuning should be correct for phase modulation.

Use the same methods of assembly, wiring, and tuneup for power output as with the oscillator stage. You do not need much gain, if any, in this stage.

The 8–24 MHz Tripler Stage

A frequency multiplier has the advantage that generally (though not always) it is

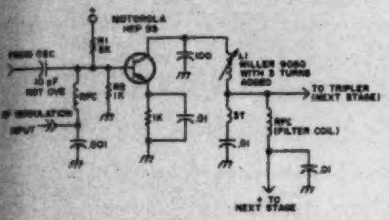

MOTOROLA
HEP 33
R1
8K
FROM OSC
10 pF
NOT OVR
RFC
R2
1K
AF MODULATION
INPUT
.001
1K
.01
100
L1
MILLER 9050
WITH 3 TURNS
ADDED
TO TRIPLER
(NEXT STAGE)
3T
.01
RFC
(FILTER COIL)
.01
+ TO
NEXT STAGE

Fig. 25. Schematic of phase modulator/amplifier.

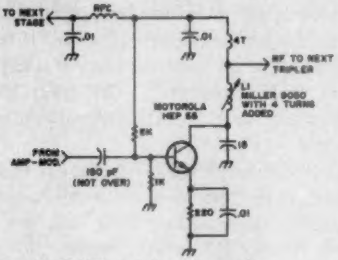

TO NEXT
STAGE
RFC
.01
.01
4T
RF TO NEXT
TRIPLER
L1
MILLER 9050
WITH 4 TURNS
ADDED
MOTOROLA
HEP 55
8K
FROM
AMP-MOD.
150 pF
(NOT OVER)
1K
18
220
.01

Fig. 26. 8 MHz tripler schematic.

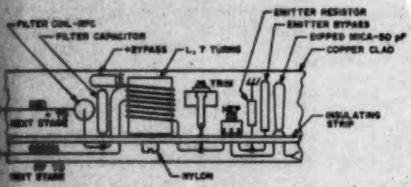

FILTER COIL-RFC
FILTER CAPACITOR
+BYPASS
L, 7 TURNS
EMITTER RESISTOR
EMITTER BYPASS
DIPPED MICA-50 pF
COPPER CLAD
TRIM
+ TO
NEXT STAGE
INSULATING
STRIP
RF TO
NEXT STAGE
NYLON

Fig. 29. 24 MHz tripler wiring diagram.

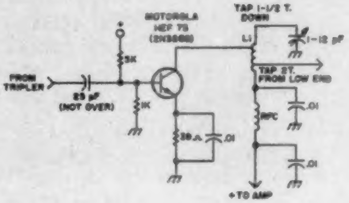

+
MOTOROLA
HEP 75
(2N3866)
TAP 1-1/2 T.
DOWN
L1
1-12 pF
3K
FROM
TRIPLER
25 pF
(NOT OVER)
1K
TAP 2T.
FROM LOW END
.01
RFC
30Ω
.01
.01
+TO AMP

Fig. 30. 73 MHz doubler schematic

free from self-oscillation, due mainly to the output and input circuits being on different frequencies. The bias requirements are different in a tripler from those of a doubler or class C straight-through amplifier, but this can be adjusted simply by varying the emitter resistor during tuneup for maximum output on the desired frequency. Figure 26 shows the schematic of this stage, where the base input coupling capacitor is seen to be much larger than in the preceding stage. However, in spite of a small tap winding and low impedance in the preceding stage it is easy to cause superregeneration in the base circuit if the coupling capacitor is too large. I found that 150 pF or slightly less is a good value.

The wiring side layout for this stage, which is typical of the multiplier circuits, is shown in Fig. 27. A logical wiring system is seen to prevail, especially as regards the emitter, base, and collector wiring and their components. Two extra wires are used, one red for the B+ and one green for the base input rf circuits, with a filter coil separating the plus of each stage.

A 24 MHz diode detector is clipped onto the rf output tap on the inductor (Fig. 27), as was done in the preceding stages. Be very *sure* you're on 24 MHz, and not on 16 or 32. Here again you should be able to light a 48 bulb with rf with a 5–180 pF trimmer in series for matching. The collector tuning and power output curve with emitter resistor lowering should be clean and smooth.

As mentioned in the test equipment section, it is a real *must* to *listen* to the carrier as you build it up in frequency. I do this with a little af amplifier continually connected to the diode detector output because the carrier has to be free of all spurious noise, squeals, frequency and power jumps, etc.

The Tripler to 73 MHz

This one proceeds in a similar fashion to the previous stage, except that now we begin to use capacitor tuning of the collector coils. The iron-core coils of the Miller 9050 series do not do a good job here, and so far I have not found good ones at reasonable cost, so you have to wind your own but that is very easy, as you will see.

Figure 28 shows the circuit and values obtained by tests here. Do not exceed the value of 50 pF for the base input capacitor. In case of any spurious noise, this is the first place to look; in fact, I always start off with a trimmer at that point to make sure and get the maximum drive possible *without* noise.

When the stage is assembled and wired and under test as done with the previous stages, once again, look out for those *undesired* harmonics, especially the 64 MHz one in this case. It'll sneak up on you if you're not real careful!

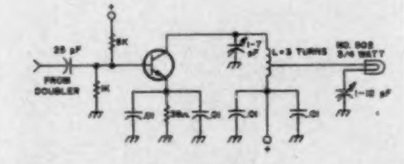


Fig. 31. 146 MHz amplifier schematic.

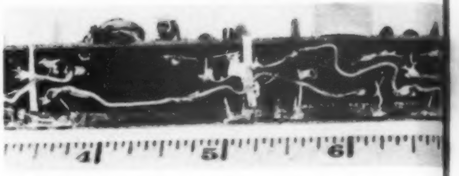
The inductor may be fastened to the mounting strip with a nylon screw (Fig. 29) for ruggedness. The variable capacitor does all right standing up on end with the fixed plates soldered to the baseboard, and the movable plates brought out through the strip with a piece of 16- or 18-gage wire, where it is joined up with the collector, as can be plainly seen in Fig. 29.

Clip on your diode detector for power checks and frequency. You can't check this latter too often, believe me. After testing for power control and noise, you are ready for the next stage, a doubler.

The Doubler to 146 MHz

This stage uses a Motorola HEP 75 (2N3866), always a lively powerful one for VHF. The schematic, shown in Fig. 30, is quite similar to the others except for the different transistor and another coil tap. The base input capacitor worked out at 25 pF maximum, with a 39Ω emitter resistor to keep the power up for maximum input into the final stage. The collector lead is cut off and the collector connection is made by soldering a 1/8-in.-wide soft and thin copper strap, which increases the heat-sinking as well as rf conduction, directly to the HEP 75 case.

Clean the case well by scraping at the place to be soldered. Use small solder, a small iron, rub the iron gently on the case two or three times for about one second only to effect a good joint for the collector strap over to the coil. The inductance is not actually critical but should be correctly tuned up and tapped for the collector as well as the output tap. After all you *do* need all the power you can get into that final.

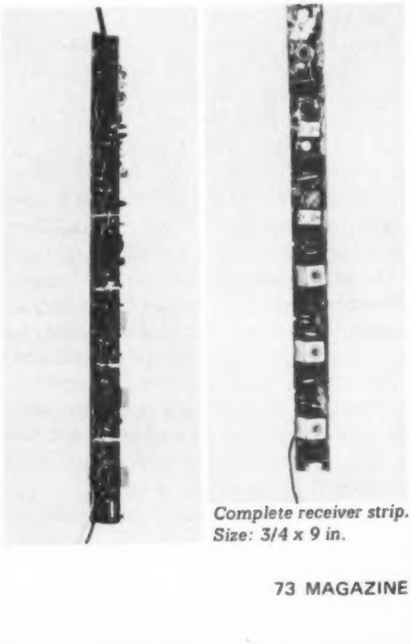


Closeup of wiring side of insulated strip.

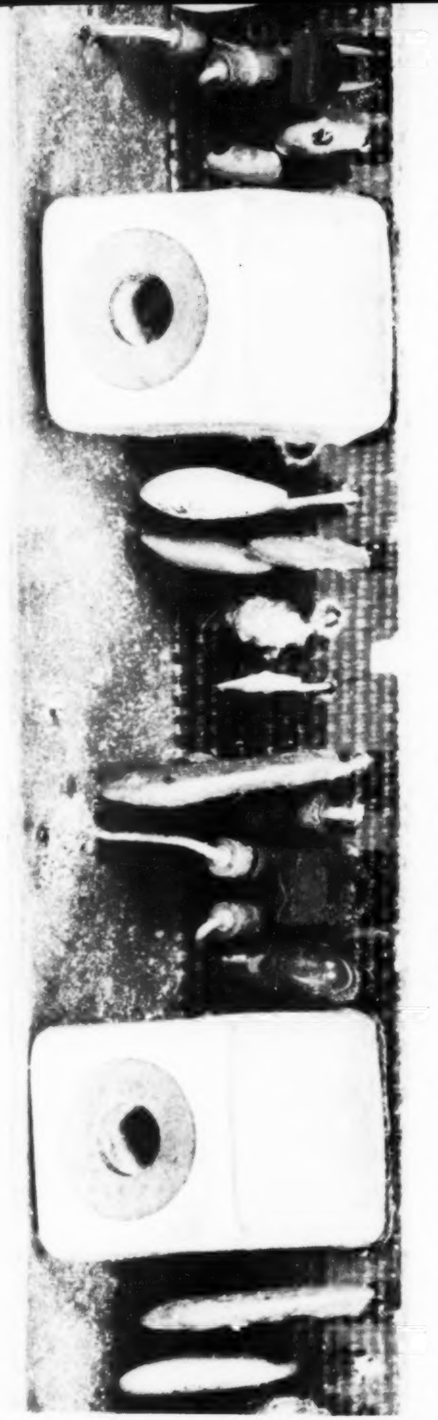
You could use a little larger emitter resistor, for a little less current, but here again power is a point to watch. I find about 50 to 120 mW of rf at 146 MHz at the output tap, depending on the plus voltage also. Of course, you can play around with up to 18V if you want to push out a bigger signal. Before buttoning up this stage, check it once more for frequency, please.

Power Amplifier

Refer to Fig. 31. Everything went along nicely with this one also, as in the previous



Complete receiver strip. Size: 3/4 x 9 in.



Blowup view shows degree of miniaturization

stage. You will note a nice feature, true of most electronic circuits that are good and foolproof, that when everything is tuned up correctly and matched properly the whole stage becomes less critical all around. That is, the tuning is not touchy, the power goes up and down nicely, and even the output tap is not too critical. Note that with small emitter resistors of under 50Ω the collector current can get pretty high, so always keep at least 10Ω in series, as you test for the best emitter resistor value. Don't forget that 1W is 100 mA at 10V. And for a watt out you will need more than 100 mW even at 15V. "Big" transmitters (50 watters) use as low as 0.1Ω at times in this place, and in some of the new heat-sunk jobs (out of our price range) the emitter goes directly to ground.

I suggest currents of not over 100 mA for this stage. The arrangement shown uses about 50 to 60 mA, depending on drive from the tripler, B+ voltage, and output loading.

Two bypass capacitors are used in the collector circuit. A test bulb (5V at 150 mA), in series with a 1–12 pF trimmer to ground, indicates rf output and loads the collector circuit. Without the test bulb or any antenna loading you can expect self-oscillation as the HEP 75 gives plenty of action on 146 MHz. The output tap can be led into the small but good and very useful 50Ω cable (RG-174/U). This cable will then go to your changeover switch or relay for the final assembly.

As a final note on the transmitter, each tuned circuit of the multipliers and finals should also be adjusted while listening to the carrier modulation. I didn't find any of these at all critical but "the books" say to do this to assure absence of phase-shift distortion in circuits after the phase modulator.

So, good luck with PM, it doesn't seem too tough to build if you avoid the fancy stuff to start with. ...K1CLL■

All Motorola ICs for this project are available from Circuit Specialists Co., Box 3047, Scottsdale AZ 85257.

REPEATER DIRECTORY

A Directory of Open VHF/UHF Repeaters in the U.S. and Canada

An up-to-date listing of open repeaters from coast to coast, with information on range, access requirements, and other operating data. Additions, deletions, and changes should be addressed to 73 Magazine, Repeater Directory, Peterborough NH 03458.

AMERICAN REPEATERS (OPEN)

Listings in this directory are alphabetical by state, area of coverage. This concept (as opposed to a listing by actual repeater location) allows mobile operators to determine with ease the repeaters available for use along any cross-country route.

ALABAMA

W4RFR (wideband)	146.34	146.94
W4VO (NE ALA, NW GA)	146.34	146.94
K4SPP (Green Mt)	146.94	147.54
K41QU (Huntsville)	146.34	146.94
WB4QEX (Birmingham)	146.34	146.94
BARES. No tones. 60W. 3dB gain antennas. Input/output coverage well-matched. Autopatch.		
No call (Albertville)	146.34	146.94
WB4QEV (Mobile)	146.34	146.94
Mobile Co. CD. Open access; 24-hr coverage. 200 ft. 6 dB gain antennas. Autopatch under way. 50W output.		

ALASKA

Anchorage	146.34	146.94
Nome	146.34	146.96

ARIZONA

Prescott		
W7AJU (wideband)	146.34	146.94
Phoenix and surrounding area		
Arizona Rptr Assn., 30 mi. range. 60W. Eleve: 2000 ft.		
WA7CEM (wideband)	146.34	146.94
	146.16	146.76
	449.30	445.30
K7VOR	146.94	146.28
Sierra Vista		
WA7KYT (wideband)	146.34	146.94
Cochise AR FM Assn.		
Tucson		
K7PQI	146.34	146.94

ARKANSAS

W5DI (Little Rock) narrowband)	146.34	146.94
Central Arkansas Radio Emergency Net		

CALIFORNIA

Alameda County		
K6SWS	146.34	146.94
1800 Hz tone		
WB6QEO	147.00	146.34
1950 Hz tone		
Butte County		
WCECE	147.00	146.49
Contra Costa County		
WB6AAE	146.20	196.80
	449.50	444.50
(Alameda, Santa Clara, San Francisco, Sacramento, Contra Costa, San Mateo) Carrier Squelch; 1800 ft height. 80W.		
WB6AAE	449.50	444.50
(Same as above) 2.4 kHz tone burst required in event of intermod. Also interconnected to .94 remote base (1950 Hz).		
W6CX (Mt. Diablo ARC)	147.80	147.06
El Dorado County		
K4TXK/6	146.07	147.54
Fresno County		
WB6HYL, 2100 Hz	146.34	146.20
WB6HYL	146.80	146.20
W6JPU	448.00	449.93
	146.12	147.71
	51.725	51.125
	146.85	147.71
Inyo County		
WA6TTL	146.34	146.94
Humbolt County		
WB6DGJ	146.34	146.94
Kern County		
WA6UJK	145.155	146.90
Los Angeles		
WA6TIC (RTTY)	146.58	52.60
W6FNO Special jammer:	146.58	146.70
W6FNO (Radio Ranch)	146.82	146.70
Wideband. Transmissions limited by timer to 1 min. Covers San Fernando Valley, San Gabriel Valley, Pomona Valley, Paradise Valley, most of Los Angeles County, Orange County, parts of Riverside County and southern third of San Bernardino County. Elevation: 3000 ft; separate Tx and Tx sites; 350W out. User must whistle to activate initially; carrier-operated unless input channel vacated for 3 min.		
WA6NUD (Cerritos AR League)	146.34	146.94
WB6TXX	224.82	221.70
WB6VYX	224.82	146.70
Extended Southern California		
WA6UJS (Southern Calif.)	52.76	52.525
	52.525	449.95
Three receiver locations: Sunset Ridge, Mt. Lukens, and Santiago Peak. Transmitter: Mt. Wilson. 450 MHz links interconnect system elements. Base stations should listen to 449.95 talkback for possible simplex traffic on 52.525. Transmitter output power is 500W.		
WB6ZDI (Culver City). Palisades ARC	146.61	147.33
7 a.m. to midnite. No tone.		
WB6GUA (Palmdale area)	146.34	146.94
1800 Hz		
Marin County		
K6GWE	146.10	146.70
K6GEWE	448.25	443.25
No Call (San Pablo Pump Soc.)	146.40	145.47
Mariposa County		
WB6EMJ	146.06	146.76
Monterey County		
K6LY (Naval Postgrad School Club)	146.37	146.97
Nevada County		
WA6UGS (Grass Valley Rptr.)	146.34	146.94
2250 Hz		
Placer County		
WB6QVV	51.60	51.00
1800 Hz tone burst		
Sacramento County		
WA6RYO (No tone required)	146.80	146.20
San Luis Obispo County		
WB6TSO (Cuesta Peak)	146.20	146.80
San Mateo County		
WA6TSM (So. Peninsula ARC)	146.13	146.73
	448.45	443.45
K6QFO (RACES)	147.31	145.49AM
WA6BTH	51.90	51.35
San Bernardino County		
WA6UGQ (Controlled per request from UHF)	146.34	146.46
	146.34	146.94
San Diego County		
WB6WLV	146.34	146.85
Santa Clara County		
WB6OQS (SC Vly UHF Rptr. Soc.)	146.16	146.76
	449.60	444.60
	146.68AM	146.76
WB6LJR (Pacific Commun. Soc.)	51.624	51.024
	449.80	444.80
1950 Hz tone burst		
WA6UFE (Pacific Telco Empl.)	146.04	146.52

WA6YCZ (Bay Area Commun. Soc.)	146.85	147.71
	449.93	448.00
	UHF	146.34
W6DOO (Mt. Alison)	146.85	147.71
	UHF	146.34
Santa Cruz County		
K6JGE	146.928	147.60
Solano County		
WB6WYI (No. Cal. ARS)	51.60	51.0
2100 Hz tone burst		
W6AEX (Soc. of Amat. Operators)	144.20	147.85
WA6UGY (Mt. Vaca RC)	114.34	146.94
	146.49	147.00
W6GDD (on call)	146.34	146.94
Sonoma County		
WB6SXC	145.98	146.90
Tulare County		
WB60PG	145.22	146.88
2200 Hz tone burst		
WB60PG	145.62	146.76
1800 Hz tone burst		
WB6OPH	51.236	52.80

CANADA

Nova Scotia		
VE1ARC (Halifax)	146.46	146.94
VE1JD (Sydney)	146.46	146.94
VE1KI (St. John, N.B.)	146.46	146.94
VE1VHF (Moncton)	146.46	146.94
VE1XK (Truro)	146.46	146.94
Newfoundland		
VO1GT (Covers all of Cape)	146.46	146.94
Quebec		
VE2AT (Mt. Carmel) wideband	146.46	146.94
VE2CAT (Montreal)	146.18	146.64
VE2CLA (Montreal)	146.10	147.30
VE2CRA (Ottawa)	146.46	146.94
	443.30	146.94
	146.94	448.30
VE2CRS (Chicoutimi)	146.46	146.94
VE2ES (Matane)	146.46	146.94
	146.34	146.94
VE2FZ (Sherbrooke)	146.46	146.94
VE2JE (Drummondville)	146.46	146.94
VE2JE (Eastern Montreal)	146.52	147.50
VE2JE (Riviere du Loup)	146.46	146.94
VE2MT (Mt. Royal, Montoreal)	146.46	146.94
	146.46	147.06
VE2OM (Mt. Belair) wideband	146.46	146.94
VE2RM (Montreal and westward)	147.40	147.18
VE2PY (Montreal)	146.28	146.88
VE2TA (Mt. Orford; P.Q. & northern Vt.	146.52	147.50
VE2VD (southern Quebec)	146.52	147.50
VE2VD (Quebec City)	146.52	147.50
VE2XW (Mt. St. Bruno; Montreal & vic.	146.70	147.60
VE2ZO (Montreal)	146.46	147.06
Ontario		
VE3BSQ (Kingston)	146.46	146.94
VE3DRW(Hamiton)	146.16	146.76
VE3KBR	146.46	146.94
VE3KSR (Kitchener/Stratford)	146.34	146.94
VE3LCR (Grimsby)	146.52	147.42
VE3MOT (Toronto)	146.58	147.18
VE3NRS (Niagara Falls)	146.22	147.24
VE3OSH (Oshawa)	146.40	147.12
VE3PBO(Peterboro)	146.34	146.94
VE3RPT (Toronto & extended area)	146.46	147.06
VE3SIX (St. Catherine)	146.22	147.24
VESSM (Sault Ste.Marie; coverage includes N WI)	146.34	146.94
VE3SSS (Toronto)	146.64	147.30
VE3STP (Ottawa)	146.34	147.06
Manitoba		
VE4XK (Winnipeg and extended area in southern regions of Province	146.46	146.94
Saskatchewan		
VE5SS (Regina)	146.46	147.33
Alberta		
VE6OL (Grand Prairie)	146.46	147.00
Wideband. 60W. 100 mi. range		
VE6AUY (Calgary)	146.46	147.00
VE6WQ (Edmonton)	146.46	147.33
British Columbia		
VE7ACS (Vancouver)	146.34	146.94
VE7AFG (Prince George)	146.58	147.33
VE7BEL (wideband)	146.22	147.54
VE7BTU (Nelson)	146.46	147.33
VE7CAP (Kimberley)	146.46	147.33
VE7ELK (Chilliwack)	147.33	146.58
No tone; wideband		

COLORADO

Pueblo		
WAØSNO (wideband)	146.34	146.94
Colorado Springs (Cheyenne Mt.; wideband)	146.34	146.94
WØPXZ (Glad Park; wideband)	145.32	146.94
60 mi. radius average, 7100 ft.		
WØPRZ (Grand Junction; wideband)	145.32	146.94
32 mi. radius average, 4800 ft.		
WØIA (Boulder; narrowband)	146.16	146.76
1800 Hz tone burst 8100 ft. Rocky Mt. VHF Soc. (Covers Denver, Cheyenne, northeast state).		
UHF facility:	444.55	449.55
WØWYX (Denver; narrowband)	146.34	146.94
Tone burst		
WØWYX (Denver) UHF facility	444.45	449.45
Rocky Mtn. Relay League. 11,500 ft		
No call (Denver Radio Club UHF)	444.35	449.35

CONNECTICUT

WA1KEK (Bridgeport)	146.22	146.76
Multistate coverage. CARS repeater, 24-hr operation, tape-logged. 325 ft elevation for receiver gain antenna. Transmit antenna is groundplane at 200 ft. Approximately 400W out.		
WA1JTB (Trumbull)	146.31	146.88
WA1KGD (Bethany, 750 ft; narrowband)	146.11	146.61
Covers Stamford to Madison, Hartford to Long Island, N.Y. 80W. (New HavenCounty Amateur Rptr. Assn. Lts.)		
No call yet (Avon Mountain)	146.28	146.94
W1BNF (narrowband)	146.37	146.98
Southern Massachusetts and Eastern Long Island, N.Y., plus much of Connecticut.		
No call yet (proposed ARRL repeater; Newington, CT)	146.22	146.76
K1IIG (Hartford)	146.28	146.88
W1VVK (Avon)	146.34	146.94
	146.94	52.92
South to New Haven and East Long Island, north to Greenfield.		
K1ZJH (Covers most of state from Holyoke, Mass.	146.34	146.94
WA1KFZ (Covers north part of state from central Mass.)	146.04	146.91
Addl. rptr. planned for .34/.94.		
WA1KFX (Mt. Snow, Vermont)	146.31	146.88
WA1DMX (Vernon)	146.25	146.82
No tone; autopatch. Pioneer Valley Rptr. Assn.		

DELAWARE

WA3DZD (Baltimore)	146.34	146.76
	52.525	146.82

FLORIDA

Northern Florida		
No call given (Starke; narrowband)	146.34	146.94
Central Florida		
WB4HAE (Tampa; narrow)	146.34	146.76
WB4QEN (Tampa)	444.1	449.1
WB4GLK (Okeechobee; east central area; narrowband)	146.34	146.94
WB4GLK (Same)	146.94	146.76
W4IKB (Chipley)	146.34	146.94
W4GGU (Panama City)	146.34	146.76
Northwest Florida		
WB4KLT (Ft. Walton Beach)	146.34	146.76
Whistle-on Whistle-on, 1800 Hz narrowband. Split site. Receiver: Destin, Florida. Transmitter: Ft. Walton Beach. Maximum directivity, rcvr: north. Antennas approximately 40 miles. Uplink, downlink, and controls via		

450 MHz. Autopatch. After ID, system shuts down and requires new tone for reactivation.
WA4EVU (Ft. Walton Beach; 146.34 146.76
wideband)
WB4KNQ (Brevard Rptr. Assn.) 146.34 146.76
60W; 150 ft height; gain antenna.
Narrowband. Touchtone control via UHF link.
W4UC (Pensacola & vicinity; wideband) 146.34 146.76
2.2 kHz tone; 5 Flags ARS
Southern Florida
WB4HAA (Miami; no tones; narrowband) 146.34 146.76
(Southern Florida FM Assn.) From University of Miami, covers from Pompano Beach to Florida City. Receiver equipped with preamp. 100W transmitter. Touchtone autopatch.

GEORGIA

W4BOC (Decatur) 146.34 146.76
No call (Augusta) 146.34 146.94
WB4NST (Atlanta) 146.34 146.76
PRIVATE REPEATER; TRANSIENTS
REPORTEDLY UNWELCOME
W4VO N.W. GA Area
(2100 Hz). 146.34 146.94
(no tone). 146.46 146.94
.... 449.475 449.85

HAWAII

KH6EQF (Diamond Head; narrowband; 146.20 146.80
linked to other EQF systems) ... 147.00AM 146.80
.... 52.525 53.520
KH6EQK (Mt. Holeakala; narrowband) 146.34 146.94
.... 146.20 146.80
KH6EQL (Waialua; narrowband) 146.20 146.80
All Hawaii repeaters operated and maintained by Honolulu Emergency ARC.
KH6NLH (Waipahu) 146.16 146.76
KH6EQR (Lualualei) 146.34 146.94

IDAHO

K7ZZL (Deer Pt) 146.34 146.94
Boise Valley Repeater, 7000 ft elev. Open. Wideband.

ILLINOIS

Northern Illinois
WA9WVA (Batavia) 147.66 146.58
.... 146.04 146.58
No tone. N. Ill. ARC.
10 sec. dropout relay.
WA9EAW (Aurora) 45 mi. range 147.40 147.81
Autora FM Amateur Radio Assn.
W9FBS 146.82 146.94
WA9LIV (Waukegan) (wideband) 146.34 146.76
1950 Hz tone burst
W9BYZ/9 (Genoa) 146.34 146.76
1650 Hz tone
Central Illinois
No call (Rockford) 146.82 146.94
WA9GCK (Bloomington) 146.22 146.94
WA9EAM (Petersburg) 146.34 146.94
WA9EAT (Joliet) 146.28 146.98
WA9WVB (Chamgagne/Urbana) 147.48 147.18
Chicago and vicinity
WA9ORC (Chicago FM Club) 146.34 146.76
Tone access - 1800 Hz North Receiver
2000 Hz South Receiver
60W transmitter at First National Bank Building, Chicago, Illinois. Antenna height 880 ft ERP - 200W.
Six meters: Tone access - 1800 Hz.
60W transmitter in downtown Chicago. Antenna height 500 ft. ERP - 120W.
450 System
Carrier access (open repeater)
10W transmitter at First National Bank Building, Chicago, Illinois. Antenna height 880 ft. ERP - 20W. Logic voting system under construction to accommodate 8 receiver sites for 1 meter system. Timer limits transmissions to 2 min. Coverage includes Waukegan, La Porte, Indiana, Wheaton, Chicago Heights.
WA9DZ 52.76 52.525
.... 52.76 52.64

WA9EAE (City) 146.46 146.64
WA9EAE (lower city) 146.46 146.88
.... 52.76 52.525
300 ft high, separate sites ..... 147.50 (Base only)
W9NGI (SRO CFAR) (Mobiles) 147.45 147.75
No tone (Bases) 147.50 147.75

INDIANA

Anderson
WA9WVC (Madison County) 146.34 146.76
Open daily 5 p.m. (Narrowband)
Fort Wayne
W9INX 146.46 146.88
Allen Co. Technical Society.
Narrowband; 250W.
.... 52.64 52.88
.... 448.80 444.444
WA9EAU (Fort Wayne Rptr. Assn.) ... 146.34 146.76
Narrowband; no tone. 250W transmitter
at 310 ft; receiver at 550 ft. 45 mi.
radius. Phone patch.
Schererville
W9EHZ (Midwest Rptr. Assn.) 146.34 146.91
WB9ADO Split site. 146.40 146.91
Secondary freq: 146.34 146.76
Indianapolis
WA9HRK 146.46 146.88
K9LEH 146.34 146.76
Muncie
(No call). 146.34 146.94

IOWA

Clinton area
K9ITW 146.34 146.94
WA8PUD 146.34 146.94
K0IXR 146.34 146.94
Polk Co. Rptr. Assn. Narrowband. Whistle-on (1.2–1.3 kHz). Timer-limited to 2.5 min. 90 ft. antennas. 50W out. 30 mi. radius of coverage.

KANSAS

Southeast Kansas
W0DKU (Wichita) 146.34 146.94
W0IPB 146.34 146.94
Wideband repeater with autopatch. Covers southeastern and south central portion of state. Input continuously monitored.
W0IPB 146.22 146.82
Wideband repeater similar in design, construction, and coverage to that of W0DKU.
Topeka area
WA0SNP (wideband) 146.34 146.94
Northeast Kansas
WA0OFH (KC) (wideband) 146.34 146.94
WA0OFH (KC) (wideband) 52.70 2.525
Central Kanses
WA0CJQ (Salina) 146.34 146.94

KENTUCKY

W4MOP (Louisville) 146.34 146.94
K4UCS (Ownesboro) 146.34 146.94

LOUISIANA

New Orleans Area
W5UK 146.34 146.94
Whistle-on. 1.8 kHz tone to start, then COR until 10 sec after squelch fail. Narrowband. New Orleans VHF Club.
Baton Rouge
WA5ZHD (narrowband) No tone 146.34 146.94
Alexandria
WA5MZZ (narrowband) No tone 146.34 146.94
Lake Charles
W5WN (narrowband) No tone 146.34 146.94
Monroe
W5GQZ (narrowband) No tone 52.827 52.525
Antenna height 1000 ft.

MAINE

W1GZS (Sanford) 146.13 146.73
Touchtone linked to KIMNS, Derry N.H.

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TRUCKLOAD SALE. SPECIAL LOW PRICE!

Freq. range	136 MHz to 174 MHz
Amplifier tubes	pair of 4X150A's
Input excitation	2 watts to 15 watts
Power output	250 watts to 700 watts *
Type of operation	Class C, push-pull
Input/output impedance:	50 ohms
A.C. power:	115 or 230 vac

This is a completely self-contained power amplifier designed specifically to increase the power output of low power transmitters. It requires no modifications to operate on rtty, fm, mcw, etc. in the above listed freq. range. It will deliver 250 to 300 watts out when driven by a 2 or 5 watt handie talkie! The power output can be increased up to 700 watts with a very simple modification. (Change tubes to 4CX250B's, make minor change in power supply, instructions supplied with each unit.) Very compact (26¾ inches H, 20¼ inches W, 16½ inches D.) Fully metered, antenna change over relay, blower motor. No external keying circuits required. Amplifier keys automatically. (Just hook a piece of co-ax from your low power base or handie talkie and push the mike button!) Original cost: $2,100.00. Our price, brand new, unused, complete with instruction manuals is only $350.00 FOB Trenton, Mich.

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FM Station Monitors, 40-50 MHz F4M24B1C	$85.00*
Dispatcher power supplies, 12 v NU 169	$19.95
450 MHz receiver strips	$14.95
U44 BBT "T" power 12 v 450 MHz mobiles	$75.00*
T43 GGV 150 MHz 6/12 v 30 watt mobiles	$100.00
a.c. power supplies P846, for Motorola R-394 & 257 receivers, etc.	$12.95*
VHF to UHF repeaters	$125.00
40-50 MHz receiver strips	$12.00
U43 GGT 150mc, 30 watt, 12 v mobiles	$149.00
150 MHz "HT" handi-talkies, like brand new, w/batt	$250.00
T41 GGV 6/12 v 30 watt, 40-50 MHz mobiles	$39.95*
450 MHz 20 watt transmitter strips	$12.50
T44 AAV 6/12 v 450 MHz mobiles	$24.95*

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FM BULLETIN

Contains those rare copies of the Bulletin that nobody seems able to find any more. From the first issue of FM Bulletin to Feb 1968! Printed in chronological sequence as edited by Mike Van Den Branden (WA8UTB). 8½ x 11 in.

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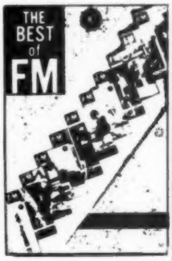

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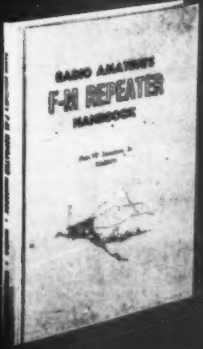

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the Handbook tells . . .

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the Handbook tells . . .

- how to prepare for a repeater
- how to get a repeater site
- how to build a repeater
- how to keep a repeater on the air
- how to determine a prospective repeater's range
- how to get your repeater license

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MARYLAND

Baltimore		
WA3DZD	146.34	146.76
WA3DZD	146.22	146.82
WA3DZD	448.10	449.10
Silver Spring		
WA3CJD	52.76	52.565
W3JCN	448.00	449.00

MASSACHUSETTS

K1ZJH (Covers most of state)	146.34	146.94
WA1KFY (Marlboro)	146.22	146.82
	146.34	146.82
Tone burst entry: 1.8 kHz		
WA1KFY	52.525	146.82
WA1KFY	146.22	52.525
852 Hz on 1.8 kHz tone Full digital/touchtone autopatch. Three-minute phone call limit by timer. Repeaters interconnect at will with W1ALE and K1ZJH.		
WA1KFX (Mt. Snow VT)	146.31	146.88
WA1KFZ (No. Adams)	146.04	146.91
K1MNS (Derry NH)	146.25	146.76
	444.25	447.25
Covers northeastern Massachusetts		
W1ABI (Killington)	146.28	146.88
2400 Hz	146.28	146.94
1800 Hz	146.34	146.88
2400 Hz	146.34	146.94
W1VAK (Cape Cod)	146.34	146.94
WA1KGM (Mt. Ascutney)	146.16	146.76
W1ALE	146.34	146.94
Operates .34–.94, except every 15 min., when it converts to 146.46/146.94 and 52.525/146.94. (God knows why.)		
W1WAK (New Bedford)	146.34	146.94
W1BL (Princeton)	53.54	50.50
WA1KGL (Woburn)	146.28	146.88
K1ABR (Providence RI)	146.10	146.70
No call (Lenox Mountain)	146.25	146.76
	146.25	146.94
No call (Williamstown)	146.34	146.94
K1IRH (Cape Code)	146.34	146.94
Springfield	440.65	447.65
Springfield	440.70	447.70
W1DPD (Cambridge)	146.34	146.94

MICHIGAN

Benton Harbor		
K8JKI	146.34	146.76
Grand Rapids		
WA8AAT supplied info:	146.34	146.94
Lansing		
No call given	146.34	146.94
Oshtemo		
K8TIW (24-hr operation)	146.34	146.94
Detroit area		
WA8BDD (Clarkston)	146.34	146.76
Serves southeast Michigan. (No tone req.)		
WB8CQS	146.34	146.76
(Includes 450 MHz links from Trenton, Grosse Pointe, and Farmington. No tone req.)		
K8VLN (Detroit Area Rptr. Team; narrowband)	146.46	146.64
70W transmitter, gain antennas. Transmitter height: 275 ft; Receiver height: 435 ft. No tones required.		
Pontiac-Rochester		
No call given	146.46	146.94
Kalamazoo		
K8TIW	146.34	146.94

MINNESOTA

Twin Cities (St. Paul; Minneaplis)		
W0PZT (Mobile Amateur Radio Corps of Hennepin County)	146.34	146.46
W0CKF	146.94	146.46
	53.64	146.46
	146.94	53.64
Talklock system; priority input is .34; courtesy input is .94. No tones req; 24-hour operation. Deviation: compromise (±10 kHz)		
No call given (Elk River)	146.34	146.94

MISSISSIPPI

K5TYP (Keesler AFB)	146.34	146.94
Serves Biloxi and area from Alabama to Bay St. Louis. 2.0 kHz tone burst. Narrow/wide.		
WA5UEG (Bay St. Louis)	146.34	146.94
Covers Gulf Coast from Louisiana border to Gulfport, Mississipi. 1.8 kHz whistle-on. Narrowband.		
W5UK (New Orleans; narrow/wide)	146.34	146.94
2.2 kHz whistle-on. 40 mi. radius.		
WA5RMS (Gautier)		
2400 Hz	146.34	146.94

MISSOURI

Kansas City		
WA0OFH (KC, Mo. and Kansas)	146.34	146.94
WA0OFH (KC, Mo. and Kansas)	52.70	52.525
K0OKI	52.88	52.525
WA0V VB (KC, Mo. and east)	146.34	146.94
K0FRA (occasionally)	52.70	52.525
WA0AMR (full-time; open)	146.16	146.76
St. Louis		
WA0CJW	146.34	146.94
St. Louis area		
K0RWU (Chesterfield) Narrow	52.05	51.25
Wide	441.56	449.56

MONTANA

Butte, Anaconda		
No call given	146.34	146.94

NEBRASKA

Omaha		
W0EQU (Ak-Sar-Ben RC)	146.34	146.94
Lincoln		
WA0MFC.	146.34	146.94

NEVADA

K7UGT (Reno) Sierra New ARS	146.34	146.94
2400 Hz tone burst		
COR	146.94	147.48
W7AKE (Las Vegas) (9000 ft.)	146.20	146.80
	147.18	147.84
	147.18	51.525
	52.525	147.84
	52.525	53.275
K7UGE (Las Vegas)	146.34	146.94
146.20 input has priority over 147.18 and 52.525 inputs. 146.34 input is intermittent only; energized on request and on special occasions. All repeaters are open.		
WA7NHV ((Capable of crosslink)	146.34	146.49
	147.00	146.94
WA7HXO (Las Vegas Rptr. Assn.)	146.40	146.94
No call given (Elk River)	146.34	146.94

NEW HAMPSHIRE (See also listings for Mass.)

W1ALE (Concord)	146.34	146.94
	146.34	146.94
	52.525	146.94
	146.94	52.525
	146.46	146.94
Covers south and central portions of state, plus northeast portion of Massachusetts. Operates .34–.94 except every 15 minutes, when it operates .46–.94 and 52.525-A4 for 3 minutes.		
K1MNS (Derry)	146.25	146.76
	444.25	447.25
Covers southern and southeast portions of state plus northeast edge of Massachusetts.		
WA1KFX (Mt. Snow)	146.31	146.88
Covers Vermont, south central, and southwest New Hampshire, plus northwest Massachusetts.		
1800 Hz	146.31	146.94
1950 Hz	146.34	146.94
2250 Hz	146.34	146.88
WA1KFZ (N. Adams, Mass.)	146.04	146.91
K1ZJH (Mt. Tom, Mass.)	146.04	146.94
Covers southwest New Hampshire plus western areas of Massachusetts		
Soon to change input to 146.40	(146.40)	146.94
W1ABI (Killington, Vermont)		
2400 Hz	146.28	146.94
1800 Hz	146.34	146.88
2400 Hz	146.34	146.94
(See complete list under N.Y.)		

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AGC circuit at the front end
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REAR panel has provision for 25w unit,
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Includes transceiver, two channels supplied, mobile mount, microphone, coax cable, Hustler antenna, and built-in AC-DC power supply.

SPECIFICATIONS

General

Frequency Coverage	144-148 MHz	
Number of Channels	12 Channels, 3 supplied	
	Channel 1	Receive 146.94 MHz Transmit 146.34 MHz
	Channel 2	Simplex 146.94 MHz
	Channel 3	Receive 146.74 MHz Transmit 146.34 MHz
Modulation	Frequency Modulation	
Transmitter Control	Push-to-Talk	
Power Drain	AC: Receive 6 Watts Transmit 50 Watts DC: Receive 0.5 Amps Transmit 4 Amps	
Power Source (Built-in)	AC: 117 Volts 50-60 Hz DC: 13.5 Volts ± 10%.	
Dimensions	7⅞" W x 2¾" H x 10¼" D.	
Weight	8¼ lbs.	
Standard Accessories	Dynamic Microphone, Hustler Antenna, Antenna Connector Plug, AC/DC Cord, Speaker Plug.	

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RF Output Power	Greater than 10 Watts
Frequency Deviation	Adjustable to 15 kHz maximum
Frequency Stability	±.001% or less
Spurious Radiation	Greater than —80 dB below Carrier
Output impedance	50 ohms

Receiver — completely transistorized

Receiver Circuit	Crystal-controlled Double Conversion Superheterodyne
Intermediate Frequencies	1st 10.7 MHz, 2nd 455 kHz
Input Impedance	50 to 75 Ohms
Sensitivity	0.5 µV or less for 20 dB quieting. 1 µV or less (30 dB S+N/N ratio at 10 kHz deviation with 1 kHz modulation)
Spurious Sensitivity	Greater than −60 dB.
Audio Output	0.5 Watt with 10% or less distortion.

Accessory Antenna, Model BBL-144 — Hustler 3.4 dB gain quick-mount with coax— **$34.70**

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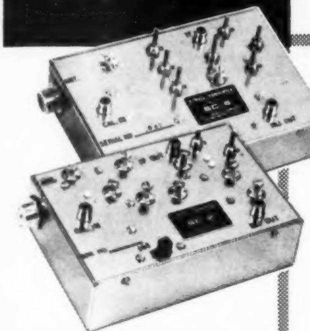

Model SC-6
for 6 meters
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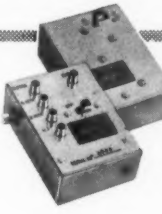

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Accessory Console CC-1 has space for both 2 & 6 M Converters, Power Supply, Xtal Cal. and extra converter.

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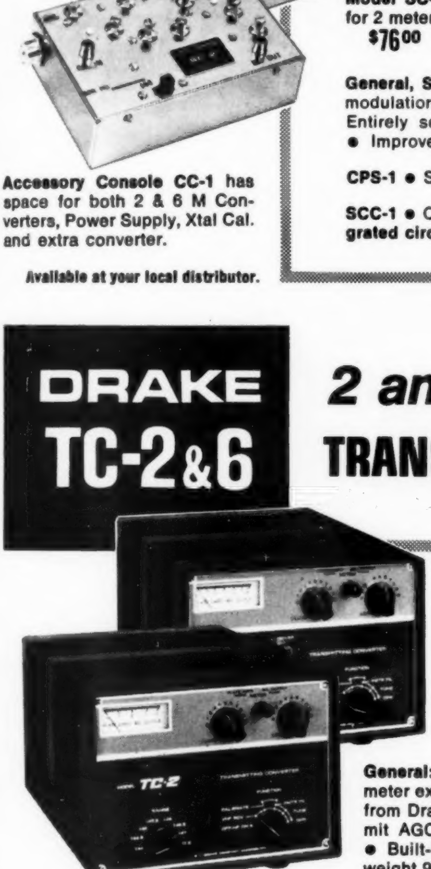

TC-2 Full 2-Meter band • 180 Watts $\$300^{00}$

TC-6 Full 6-Meter band • 300 Watts $\$250^{00}$

General: All switching from front panel • For any 20 meter exciter or TR-6 Transceiver • Oscillator injection from Drake SC-2 or SC-6 receiving converter • Transmit AGC • Plate current and relative output meters • Built-in antenna relay • 5½"H x 7⅝"W x 11⅝D, weight 9 lbs.

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WA1KGM (Mt. Ascutney)	146.16	146.76
Covers northeastern Vermont FM Repeater Association.		
2100 Hz tone burst	146.34	141.94
1800 Hz tone burst	146.34	146.88
K6MVH/1 (Peterborough)	146.34	146.94
W2NSD/1 (Pack Monadnock)	146.37	146.73
W1KOO (Mt. Mansfield, Vermont)	146.34	146.94
	146.37	146.94
Covers central and northern areas of New Hampshire, Vermont and northeast New York.		
K1ABR (Providence, R. I.)	146.10	146.70
No call (Woonsocket, R. I.)	146.10	146.70

NEW JERSEY

WA2UWR (Paramus)	146.28	146.79
PL activates repeater, which then operates on a carrier-operated basis. Control cycle limits – 3 min. Covers northern New Jersey and New York City. Wideband in, compromise out.		
WA2UWR (UHF repeater)	449.10	448.10
W2CVT	146.37	146.76
Call unknown (Ford, N.J.)	146.28	146.76
Provides coverage throughout northern regions of state.		
Call unknown (Brunswick)	146.34	146.94
Provides coverage throughout state.		
WA2UWC (Greenbrook)	146.58	146.94
Electr. Technol. Society Repeater. According to WB2CTD repeater is 34 in. Other reports indicate 58 in.		
K2ODP (Entire state)	146.22	146.82
WA2UWO	146.70	52.64
	52.56	146.76
According to WB2CTD, this repeater is not open; according to WB2AEB, it *is* open, but with PL burst because of interference.		

NEW MEXICO

Albuquerque		
WA5JDZ (Mt. Taylor)	146.34	146.94
Narrowband; autopatch. No tone required. Covers upper third of state. 11,350 ft elev.		
WA5VKY (Sandia Crest)	146.46	147.06
Narrowband; autopatch. No tones. 10,600 ft elev.		
K5FSB (Sandia Crest) Narrowband.	448.60	443.60
WA5OIP (Under construction)	146.25	146.88
WA5QXB (Under construction)	146.40	147.00
Los Alamos		
W5PDO Narrowband; autopatch	146.34	146.94
Alamogordo		
WA5KUI (Alamo Pk) Narrowband. 9800 ft. elev.	146.34	146.94
Central N.M.		
WA5YTK (Sierra Blanca) Narrowband. 11,200 ft elev.	145.50	146.50
Portales		
WA5YTG	146.34	146.94
Las Cruces		
(No call)	146.34	146.94
	146.46	147.06
Soon to move delete primary operating frequencies.		
Roswell		
WA5DMQ (Capitan Summit) 10,200 ft elev.	146.34	146.94

NEW YORK

Long Island (All narrowband)		
K2HOI (whistle-on)	146.34	146.76
WA2UYI (PL: 107.1, 151.4, 162.2 Hz)	441.75	446.75
W2OQI (Manorville; 2588 tone burst)	146.34	146.82
	146.52	146.76
W1BNF (Connecticut; narrowband)	147.37	146.98
WA2UWC (Greenbrook, New Jersey)	146.58	146.94
No call given	52.8	146.76
No call given	441.60	446.60
LIFMA	441.75	446.75
K1TKJ	146.25	146.73
No call given	441.85	446.85
LIMARC	146.34	146.76
No call given (Woodmere, L.I. NY)	146.41	146.64
W2DEG (Grafton)	146.22	146.76
WA2KEC (Experimental)	146.34	146.94
Moving to 146.55/146.82 soon.		
	146.34	52.72
	52.80	52.72
K1TKJ/2 (New York City)	146.19	146.73
No call (Gore Mt.) Proposed	441.0	446.0
No call (Belfry Mt.) Proposed	441.1	446.1
No call (Old Field Pt.) Proposed	441.2	446.2
WA2UWT (Cuba)	146.34	146.94
Mt. Chaos Amateur Repeater Club.		
WA2UWQ (Rochester)	146.28	146.88
Rochester Radio Repeater Assn. Solid-state, 25W.		
No call given (Whiteface Mt.) N.A.R.A.	146.22	146.76
W2CVT (Mt. Beacon) locals only	146.34	146.76
Extended coverage	146.37	146.76
Northeast New York		
WB2NNZ (Troy)	53.75	52.58
	146.34	146.94
K2AE	146.40	52.525
K2AE	146.46	146.94
K2GVI (Utica-Rome)	146.34	146.94
W2CVT (Mt. Beacon)	146.37	146.76
W2GHR	146.13	146.73
W2AWX	441.10	449.1
Call Pending (NW FM Rptr. Assn.)	441.15	446.15
Syracuse		
WA2UWF	146.46	146.94
	53.75	52.64
W1ABI (Killington, Vermont) Tone	52.92	146.94
Tone	52.92	146.88
Tone	52.92	146.70
Tone	146.28	146.88
Tone	146.34	146.88
1800 Hz Tone	146.34	146.88
2100 Hz Tone	146.34	146.94
TTY	52.92	146.70
Staten Island		
WA2YYQ (Narrowband)	146.25	146.88
TTY	146.10	146.70
TTY	146.25	146.70
	146.37	146.88
Whiteface Mountain		
WA2UYJ	146.22	146.82
	441.35	446.35
Buffalo		
K2GUG	146.34	146.94
WB2TLJ	146.34	146.94
	146.31	146.91
Lockport		
K2ECQ	146.25	146.82
W1KOO (Mt. Mansfield, Vt.)	146.37	146.94
WA2UWC (Greenbrook, NJ)	146.58	146.94
WA2UWR (N.J. repeater)	146.28	146.79
Requires 4A PL tone.		
Other repeaters serving New York:		
WA2UWO (N.J.)		
W2CVT (Conn.)		
K1TKJ (Conn.)		
WB2NNZ (N.J.)		
WA2UYP (Mt. Beacon)	441.55	446.55
Hempstead VHF Soc.		
Transitional signaling channel		446.45

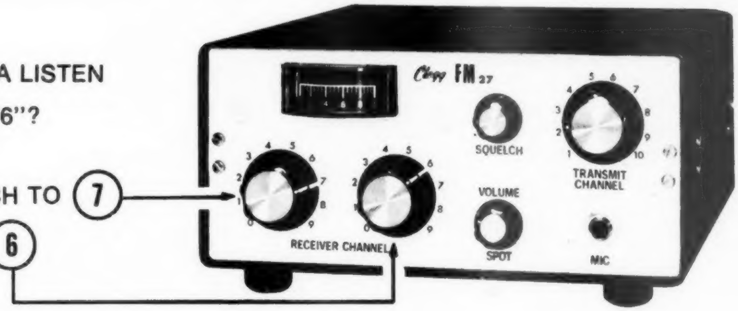
NORTH CAROLINA

North Central area		
WA4FYS (Burlington)	52.76	52.525
Has secondary output on 146.98		
Western area		
W4WID (Lenoir)	52.76	52.525
W4DCD (N. Wilkesboro)	52.525	146.90
W4DCD	52.78	52.525
WB4PPS (Roaring Gap)	146.22	146.94
No tones. 10.5 dB gain antennas. 20W system. Elevation is 2914 ft. Coverage: 100 miles plus. (Secondary of cross-connected system)		
W4BFB (Charlotte)	146.34	146.94
WA4VTX (Elizabeth City; narrowband)	146.28	146.88
200 ft 50W, 50 mi. radius		
No call given (Durham)	146.34	146.94

even if *Clegg's* new FM-27 didn't have the fantastic new Crystiplexer tuner

it would still be the best 2 meter FM transceiver on the market!

WANTA LISTEN ON "'76"? JUST SWITCH TO ⑦ AND ⑥



WHAT *IS* A "CRYSTIPLEXER TUNER"?

IT'S *Clegg's* NEW SYNTHESIZING SYSTEM.

WHAT DOES IT DO FOR THE FM-27?

IT PROVIDES INSTANT, PRECISE DIRECT-READOUT SELECTION OF 200 RECEIVE CHANNELS — WITH NO CRYSTALS TO BUY!

WHAT ARE SOME OF THE OTHER FM-27 FEATURES?

ALL SOLID STATE • EXTREMELY COMPACT • 12 WATTS OUTPUT • BUILT-IN 4½ INCH SPEAKER PROVIDES SUPERB AUDIO • DISCRIMINATOR METER • 25 μV SENSITIVITY • SPEECH PROCESSING • RUGGED • RELIABLE • 10 INDEPENDENT TRANSMIT CHANNELS • MOBILE MOUNT

DIMENSIONS— 3½" H x 7⅝" W x 9" D.

e.t. *Clegg* associates, inc. LITTELL RD., EAST HANOVER, N. J. 07936
PHONE: (201) 887-4940

New FM for '71
Standard's SR-C826M

professional quality, solid state, two-way radio, designed and sold exclusively for amateur use in the United States and Canada.

Standard Communications Corp., the world's largest manufacturer of marine V.H.F. equipment, has just developed a new industrial quality, high performance 2-meter unit. This rugged, compact transceiver is available only in the U.S. and Canada thru an authorized Standard dealer. The "826" is so compact that it makes mobile installation practical in almost any vehicle or aircraft, and it becomes fully portable with the addition of Standard's battery pack.

The SR-C826M is most frequently used as a mobile unit; however, it also makes an ideal, low cost base station unit when used in conjunction with the A.C. power supply accessory.

The popularity of 2-meter FM amateur communications is rapidly growing. In most metropolitan areas of the country 146.94 MHz is extensively monitored, and open repeaters make it possible to maintain communications over wide areas of the country. Standard's new professional quality 2-meter system now makes it possible for you to enjoy the fun of amateur mobile communication in your car for just $339.95.

STANDARD
S 2m FM

GENERAL

Freq. Range — 143 to 149 MHz, 2 MHz spread

Supply voltage — 11 to 16 VDC. Negative Ground 13.8VDC nominal

Current Consumption — .15 amp receive standby. 2.4 amp transmit

Number of channels — 12-Supplied with 4 channels

1) 146.94 Simplex
2) 146.34/94
3) 146.76 Simplex
4) 146.34/76

Microphone — Dynamic

Dimensions — 6⅞"w x 2½"h x 9⅞"d

Weight — 4½ lbs. max.

Frequency stability—.001% (−10 to +60°C)

TRANSMITTER

RF power output — .8 or 10 watts

Output impedance — 50 ohms nominal

Deviation — Internally adjustable to ±10 kHz min. factory set to ±7 kHz

Spurious and harmonic attenuation — 50dB below the carrier power level

Type of modulator — Phase

RECEIVER

Sensitivity — .4 or less microvolts for 20 dB quieting

Squelch sensitivity — Threshold — .2 microvolts or less

2 MOSFET RF Amplifiers
1 MOSFET Mixer

Deviation acceptance — Up to ±15 kHz deviation

Spurious and image attenuation — 65 dB below the desired signal

threshold sensitivity

Adjacent channel selectivity (30 kHz channels) 60 dB attenuation of adjacent channel

Type of receiver — Dual conversion superheterodyne

Audio output — 5 watts For external speaker

$339.95

(complete as shown with microphone, built-in speaker and external alternator whine filter.)

STANDARD COMMUNICATIONS CORP.

World's largest manufacturer of marine V.H.F. equipment

P.O. Box 325, Wilmington,
Calif. 90744 (213) 775-6284

K4HXD (Knoxville, TN)	146.34	146.94
	146.38	146.94
146.38 has priority. Wide in, compromise out.		
K41TL (Raleigh)	146.34	146.76
W4DCD (Wilkesboro)	146.42	52.525
	52.525	146.42
	52.78	52.525

OHIO

WB8C RV (Cleveland)	146.28	146.88
According to K8IDT, the repeater-frequencies have changed from .88/.40 to those shown here. *FM Hybanders, Inc.*		
No call (Columbus)	146.34	146.76
K8PWL (Fairfield Co.)	146.22	146.88
Users requested to announce time data and repeater call.		
W8AIC (Delaware/Westerville)	146.34	146.76
Users requested to announce time for tape log. Three-minute timeout.		
W8QLS	146.62	146.97
WB8CQK (Dayton) Untoned	146.34	146.76
1250 Hz	146.34	146.94
Base stations:	146.28	146.82
WB8CQO (Toledo)	146.34	146.76
60W transmitter; 50 mi. radius		
W8IOO (Youngstown; narrowband)	146.34	146.76
K8EUR (Ashtabula)		
Coverage radius: 30 mi., 350W. Plans to raise antennas in near future.		
Mobiles:	146.34	146.76
bases	146.25	146.76
WB8CRS (Cincinnati)	146.34	146.94
1800 Hz tone burst		
K8JHG (Ottawa)	52.76	52.525
Secondary system operates on 53.36/53.54. Uses gain antennas, low power. No tones required.		
	146.28	146.88
WA8PLZ (Miamisburg)	146.22	146.82

OKLAHOMA

Oklahoma City		
WA5ONI	146.34	146.96
(Mid-Oklahoma Repeater, Inc.) 1477 Hz (center frequency) whistle-on system. Touchtone activates with numerals 3, 6, 9, or #. After tone actuation, repeater is carrier operated until 30 seconds elapses without signal input. Output deviation is ±8 kHz. Contains links on secondary repeater channels in the 220 and 450 MHz bands. ERP: 2 kW.		
Enid		
WA5QYE (500W)	146.34	146.94
Bartlesville		
WA5LDJ	52.525	146.94
	146.34	146.94
Ponca City		
No call	146.34	146.94
Chickasha		
W5MQA (Sentry Crystals)	146.34	146.94
	449.45	444.45
	146.37	146.97
Ardmore		
No call	146.34	146.94
Durant		
No call	146.34	146.94
Cherokee		
No call	146.94FM	145.96AM
Central/Eastern Oklahoma		
WA5LVT (Tulsa)	146.34	146.94
	52.68	52.525
The repeater has its main transmitter at the National Bank of Tulsa Building with a satellite transmitter just installed at Bartlesville, Oklahoma operated by K5YZO. Main transmitter output is 450 watts. Satellite transmitter power is 15 watts. The system receives on 3 remote receivers located around the area. The highest receiver site is on the Channel 6 TV tower north of Sand Springs, Oklahoma.		
WA5KWH (Tulsa)	146.22	146.82
Touchtone controlled; # sign activates. Whistle-on planned.		

OREGON

Portland		
K7DVK	447.17	449.17
K7UGN	146.76	146.58
According to some readers, this repeater should be deleted, but W7DVR reports the repeater still operational.		
W7DBS (Eugene)	146.34	146.94
W7VS (Portland)	146.76	146.58
No call given (Newport)	146.76	146.94
No call given (Dalles; Mt. Livingston)	53.46	52.92
No call given (Pendleton)	146.34	146.76
No call given (LaGrande)	146.34	146.76
W7OFY (Medford)	146.34	146.94

PENNSYLVANIA

WA3IPP (Sellersville)	146.28	146.76
	146.34	146.76
WA3KUR (Philadelphia)	52.76	52.525
WA3KUR (Philadelphia)	52.76	52.64
WA3BKO	146.22	146.82
(Philadelphia intercity repeater)		
WA3IGS	52.80	52.72
	146.28	146.76
Baltimore	146.22	146.82
WA3BKO (Harrisburg-York)	146.22	146.82
WA3ICC (Harrisburg)	146.34	146.76
K3PQZ (York)	146.34	146.76
WA3KUW (State College)	146.34	146.76
No call given (Sayreville)	146.40	146.40
K3ZTP (Coatsville)	146.22	146.82
K3UQD (Pittsburgh)	146.34	146.94
Alternate:	146.34	146.76

RHODE ISLAND

K1ABR (Providence; narrowband)	146.10	146.70
Rhode Island coverage also available from active repeaters in neighboring states.		
(Woonsocket; narrowband)	146.10	146.70

SOUTH CAROLINA

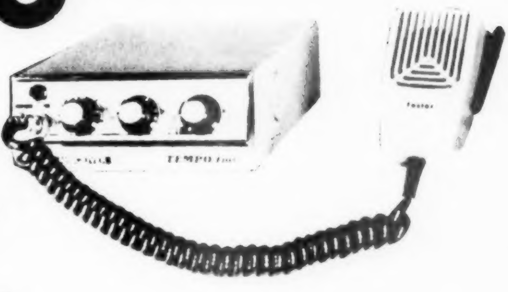
WB5PLN (Columbia)	52.76	52.525
	146.34	146.94
60-70 miles radius. Central portion of state.		
WA4SSJ (Greenville)	52.76	52.525
WB4BLN (Columbia)	146.34	146.94
	52.76	52.525
Split-site system. Open; carrier-operated. 50 mi radius of coverage.		

TENNESSEE

Nashville		
W4AY (narrowband)	146.10	146.64
W4RFR (wideband)	146.34	146.94
WB4QEY (narrowband)	146.04	147.18
Covers north-central Tenn. Autopatch with 2805 Hz Secode. Repeater on Music Mountain, near Gallatin. Link frequencies on 450 MHz.		
WA4YND (narrowband)	146.70	147.70
WB4EKI (narrowband)	146.04	147.18
Chattanooga		
WB4KLO	146.34	146.94
Tape voice ID at 3 min. internvals. Chat. Tri-State FM Assn.		
Shelbyville		
W4IWV	146.94	146.94
Memphis		
W4CV	146.34	146.94
Knoxville area		
K4HXD (Walland)	146.38	146.94
	146.34	146.94
146.38 input has priority. Also covers portions of N.C.		

BRAND NEW FROM HENRY

TEMPO FM-V



SETTING NEW HIGHS IN PERFORMANCE and VALUE!

THE EDITOR OF 73 SAYS...

"...More rf power output than any other all-transistor FM unit tested."

"...Introduction of the low-priced Tempo FM-V turns the 2m FM transceiver market into a whole new ballgame."

249^{00}

FM-V PERFORMANCE SPECIFICATIONS

OVERALL
Frequency Range: 146–148 MHz
No. Channels: 8
Power Supply Requirements:
12–15 VDC at 2A

Dimensions:
2.36 in. high
5.9 in. wide
7.66 in. deep
Weight: 4.5 lb
Active Devices:
Transistors – 26
Integrated Circuits – 2
Diodes – 15
RECEIVER
I-Fs:
First – 10.7 MHz
Second – 455 kHz

Freq. Stability:
$f_o \times 0.00001$
Sensitivity:
For 20 dB quieting – 0.6µV
Usable threshold – 0.3µV
Selectivity (at full quieting):
-6 dB at ±6 kHz
-70 dB at ±15 kHz
Audio out:
1.0W
TRANSMITTER
RF output: 12W
Multiplication factor: 12
Spurious:
Better than -60 dB
Freq. stability:
$f_o \times 0.00001$
Deviation:
Adjustable, 5–15 kHz

EXTRA FEATURES

- METERING TEST SOCKET
A built-in test socket can be used with any 50-100 µA meter to monitor all transmitter and receiver stages, including DISCRIMINATOR (for zeroing to frequency).

- OPERATION/MAINTENANCE MANUAL
A large manual includes photos and schematics as well as complete instructions for checkout, adjustment, and alignment of the transceiver.

- OPTIONAL TEST-SET ACCESSORY
An attractive test set is available as an optional add-on accessory. The test set mates with the built-in test socket, and includes a sensitive microammeter that can be switched to monitor transmitter oscillator, multiplier and driver stages as well as first and second local oscillator stages of the receiver and discriminator current. **$29.00**

- STANDARD HENRY WARRANTY
The FM-V is backed by Henry's standard warranty that is your assurance of excellence in quality of equipment, both mechanical and electrical.

Henry Radio

11240 W. Olympic Blvd., Los Angeles, Calif. 90064 213/477-6701
931 N. Euclid, Anaheim, Calif. 92801 714/772-9200
Butler, Missouri 64730 816/679-3127

The Tempo/fmv is also available at other selected distributors in different areas of the U.S. Or you can order direct and we will ship. . . across the street or around the world. Call or write for specifications and terms.

"World's Largest Distributor of Amateur Radio Equipment"

NOW

The Quality Leader In Amateur FM

At A Competitive Price

2
3
4
5
6
RF
ON
IC-2F
VOL.
SQU.

Deluxe 2 Meter FM Transceiver

Always the quality leader, (see December and January 73 Magazine, and reviews in January QST and March CQ) the IC-2F remains the same — superb performance, deluxe features, 1 year warranty . . .

TRANSMITTER: RF input power — 20 watts; RF output — 10 watts minimum; maximum frequency deviation — 15KHz (adjustable); Automatic Protection Circuit (APC) — NEW! Not offered in any other transceiver on the market. Absolute assurance of final PA protection from shorted or high VSWR antennas by instantaneous transmitter disabling; Electronically switched — no relays; Sealed low pass filter to eliminate spurious radiation.

RECEIVER: Double conversion superheterodyne; Sensitivity better than $0.4\mu V$ @ 20 db of quieting; FET front end; ceramic filters for excellent bandpass shaping; Integrated Circuit IF; built-in speaker on front panel.

GENERAL: Six channels (six transmit and six receive crystals) selectable from the front panel; large RF/"S" meter and easier to read controls; power requirements 12 to 15 volts DC.

The Deluxe IC-2F comes complete with high impedance microphone, three-position chrome mobile mounting bracket, crystals installed for two channels (Ch. 1, 146.34/146.94; Ch. 2, 146.94/146.94), power cables and plugs and manual. **Amateur Net $299.95**

Optional AC Power Supply with built-in Discriminator Meter, Model IC-3P. **Amateur Net $42.50**

PA-50A 50 watt solid state AFTERBURNER for more power mobile. **Amateur Net $129.95**

Available at your dealer

VARITRONICS INCORPORATED
2321 EAST UNIVERSITY DRIVE • PHOENIX, ARIZONA

Here's The Mobile FM AFTERBURNER

VARITRONICS
R.F.
ON
PA-50A SOLID STATE AMPLIFIER

Amateur Net
$129.95

Delivers 50 Watts of Punch on 2 Meter FM

The Varitronics PA-50A is a completely solid state Class C RF amplifier designed specifically for use in mobile amateur FM applications. Internal RF switching makes the PA-50A useable with any amateur FM transceiver with 10 watts* output. Balanced emitter devices are employed which are completely insensitive to high VSWR or even no load conditions at its output. This handsome and ruggedly built amplifier is styled like the IC-2F transceiver, features a calibrated output meter and is supplied with mobile mounting bracket and DC cord. For the big signal on FM, try it!

SPECIFICATIONS

*Drive Requirements	12 Watts Maximum 5 Watts Minimum
RF Output	50 Watts - Less with lower drive or input voltage
Power Requirements	13.5 VDC @ 5 Amps
Impedance	50 Ohms In/Out
Frequency	Any Portion of Amateur 2 Meter Band
Spurious Products	50DB Down
Dimensions	6″ X 7″ X 2″

Manufactured by Varitronics . . . still the leaders in quality amateur FM equipment.

See it at your dealers.

VARITRONICS INCORPORATED
2321 EAST UNIVERSITY DRIVE • PHOENIX, ARIZONA

TEXAS

San Antonio		
WA5UNH (Wide in, semi-wide out)S.A.R.O.	146.34	146.94
Dalls (No calls given)	53.55	52.95
	146.22	146.82
	146.34	146.94
	52.85	52.95
High power; duplexer. Operated by Regional Emergency Communications Assn.		
Northeast Texas		
WA5LDL (Tyler; narrowband)	146.34	146.94
230 ft high. 30W. Operates 6 a.m. to 12 midnight.		
No call given (Fort Worth)	53.05	53.15
WA5YTM (Fort Worth)	146.34	146.94
	146.16	146.76
	338.90	449.10
Texas VHF-FM Society, Fort Worth chapter. 50 mi. radius.		
Lubbock		
WB5BRY (narrowband)	146.34	146.94
Has autopatch, 1805 Hz digital		
W5YUO	146.16	146.76
Abilene	146.34	146.94
Austin		
W5NFCO	146.34	146.94
Amarillo		
W5CBT	146.34	146.94
Houston		
WA5QLA	146.28	146.88
No call given (Port Arthur)	146.34	146.94
W5QGG (Midland).	146.34	146.94
No call given (San Angelo)	146.34	146.94
W5TOC (Big Springs)	146.34	146.94

UTAH

East Utah		
W0PXZ (Grand Jct.,Colo.)	145.32	146.94
Salt Lake City, North Utah		
WA7AKI	146.34	146.94
K7OEP (So. Idaho)	146.34	146.94
WA7GTU (Cedar City)	146.34	146.94
Southwest Utah		
W7AKE (Las Vegas)	146.34	146.94
(plus other freqs. See Nevada listing)		

VERMONT

Central Vermont		
*W1ABI (Killington)	146.28	146.88
1800 Hz	146.34	146.88
2400 Hz	146.34	146.94
2400 Hz	146.28	146.94
Southern Vermont		
WA1KFX (Mt. Snow)	146.31	146.88
1950 Hz	146.31	146.91
2250 Hz	146.31	146.94
South and southwestern Vermont		
W1ALE (Concord , N.H.)	146.34	146.94
South and southeastern Vermont		
(Timed for periodic duty cycles)	146.46	52.525
**K1MNS (Derry, N.H.) Southeastern Vermont	146.25	146.76

*Northeast FM Repeater Assn.
**New Hampshire FM Assn.

Northern Vermont		
VE2TA (Quebec)	146.52	147.50
W1KOO (Mt. Mansfield)	146.34	146.94
2400 Hz tone burst entry. Covers northern Vermont and northeast New York. Operated by Burlington ARC		
No call yet (N. Vt.)	146.22	146.82
No call yet NW Vt.)	146.22	146.76
WA1KGM (Mt. Ascutney)	146.16	146.76
WA1KFZ (N. Adams, Mass.)	146.04	146.91

VIRGINIA

WB4HCX (Lynchburg) (wideband in, narrowband out)	146.34	146.94
W4GCE (Lynchburg)	146.22	147.42
K8SXO (Ridgeley)	146.76	52.525
W4DXC (Richmond)	52.72	52.640
K8SXO (Ridgeley)	52.525	146.76
WB4KNX (Charlottesville)	146.28	146.94
Charlottesville Emergency Amateur Repeater Society. No tones; wideband in; narrow out.		
WB4KNN (Newport News) (40 mi.)	146.34	146.94
W4NJE (Richmond; narrowband)	146.34	146.94
Whistle-on		
No call (Virginia Beach)	146.22	146.97

WASHINGTON (STATE)

W7DAQ (Longview)	146.76	53.290
Intermittent		
W7DAQ (Longview)	53.290	146.76
Intermittent		
VE7MQ (Seattle)	146.34	146.58
Seattle	146.76	146.58
K7GMR (Seattle)	52.525	53.290
450 ft elev. Groundplanes. Very sensitive receiver; 40W transmitter. Cavity homebrewed by K7KSZ.		
Yakima	145.26	147.21
K7TGH (Richland)	52.525	53.290
VE7APU	146.33	146.58
K7QKL (Mt. Rainier)	146.34	146.76
K7IUT (Olympia)	52.525	53.29
7200 ft 50W (wideband)		
K7QKL (Pikes Peak)	146.34	146.76
5200 ft 900W (wideband)		
WA7AJF (Vancouver)	52.92	53.46
Mt. Livingston; operated by Lower Columbia ARC.		
Eastern Washington		
K7LBV (Spokane)	52.525	53.29
WA7KYY (Mt. Spokane)	146.34	146.76
Operated by Inland Empire VHF Radio Amateurs. (Also covers northern parts of Idaho). Wideband.		
W7PUG	146.34	146.58
W7DXX (Rattlesnake Mt.)	146.34	146.94
K7QKL (Mt. Rainier)	146.34	146.94

WASHINGTON, D.C.

WA3CJD	52.76	52.565
W3JCN	448.0	449.0
WA3DZD	146.34	146.76

WEST VIRGINIA

K8SXO	146.34	146.76

WISCONSIN

Waukesha		
No call yet	52.72	52.64
40 mi. coverage. Milwaukee Area FM Club.		
W9AIQ (Sturgeon Bay; narrowband)	146.34	146.76
1800 Hz tone burst. 50 mi. radius. Covers northeast state and upper Michigan. Door Country ARC.		
W9ROM (Milwaukee)	146.34	146.94
WA9LIV (Waukegan)	146.34	146.76
1950 Hz		
WA9PBW (Madison)	146.34	146.76
2100 Hz		

WYOMING

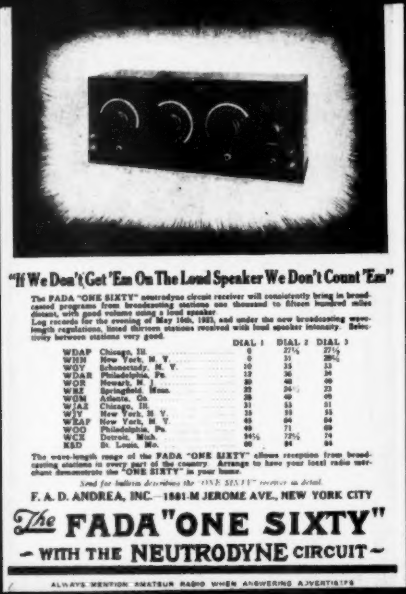
K7SDD (Sherman Hill	146.16	146.76
Covers Cheyenne and Laramie. Wideband in, 10 kHz out. Linked with WA7EGK. Wyoming Amateur Repeater Society (Slides available).		
WA7EGK (Laramie)	146.34	146.94
Wideband in, 10 kHz out. Linked with K7SDD. Has autopatch (742-2447). (Slides available).		
WA7OTP (Casper)	146.34	146.94
Linked with K7SDD		
W7RPV (Boysen Park)	146.34	146.94
Covers Thermopolis, Riverton, Lander, and Worland, Wyoming. 7500 ft. Local control.		

FOREIGN REPEATERS

Germany		
DL0STA Stuttgart	144.46	145.75
(Mounted in "Space Needle")		
Bavaria		
No call (Zugspitz Mt.)	145.0	145.6

AMATEUR RADIO – 50 YEARS AGO

The ads reprinted on this page are about 50 years old. They are published here in their original form, unretouched. 73 thinks you'll enjoy this capsule view of the past. If you want to see more of these reproductions in future issues, drop us a line. . .we've got a million of 'em!



"If We Don't Get 'Em On The Loud Speaker We Don't Count 'Em"

The FADA "ONE SIXTY" neutrodyne circuit receiver will consistently bring in broadcasted programs from broadcasting stations one thousand to fifteen hundred miles distant, with good volume using a loud speaker.

Log records for the evening of May 16th, 1923, and under the new broadcasting wavelength regulations, listed thirteen stations received with loud speaker intensity. Selectivity between stations very good.

		DIAL 1	DIAL 2	DIAL 3
WDAP	Chicago, Ill.	0	27½	27½
WHN	New York, N. Y.	0	31	29½
WGY	Schenectady, N. Y.	10	35	33
WDAR	Philadelphia, Pa.	13	36	36
WOR	Newark, N. J.	30	40	40
WBZ	Springfield, Mass.	22	24½	23
WGM	Atlanta, Ga.	28	40	49
WJAZ	Chicago, Ill.	31	53	51
WJY	New York, N. Y.	35	55	55
WEAF	New York, N. Y.	45	64	64
WOO	Philadelphia, Pa.	49	71	69
WCX	Detroit, Mich.	54½	72½	74
KSD	St. Louis, Mo.	60	84	84

The wave-length range of the FADA "ONE SIXTY" allows reception from broadcasting stations in every part of the country. Arrange to have your local radio merchant demonstrate the "ONE SIXTY" in your home.

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– WITH THE NEUTRODYNE CIRCUIT –

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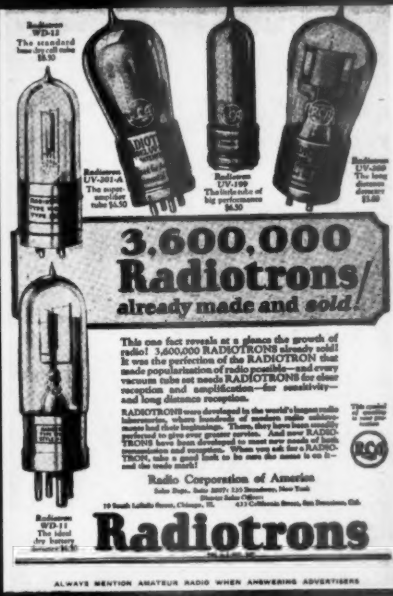

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Radiotron UV-200 The long distance detector $5.00
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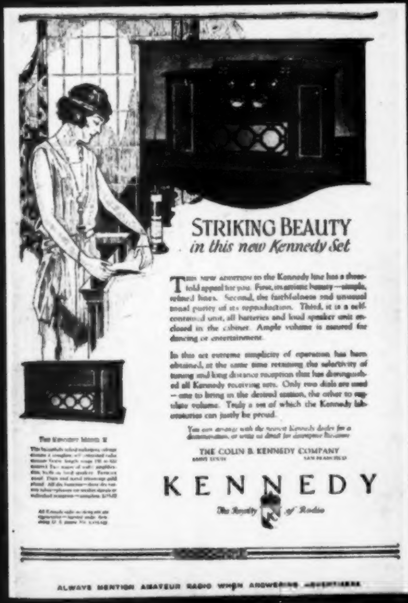

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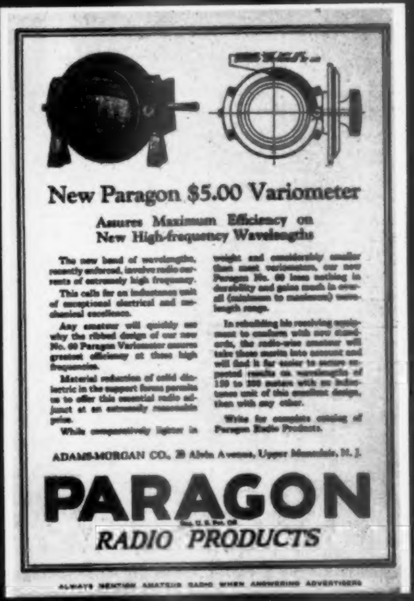

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Assures Maximum Efficiency on New High-frequency Wavelengths

The new band of wavelengths, recently enforced, involve radio currents of extremely high frequency.

This calls for an inductance unit of exceptional electrical and mechanical excellence.

Any amateur will quickly see why the ribbed design of our new No. 60 Paragon Variometer assures greatest efficiency at these high frequencies.

Material reduction of solid dielectric in the support forms permits us to offer this essential radio adjunct at an extremely reasonable price.

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see the *Mann*

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Money refunded without question if equipment is returned within seven days from shipment, undamaged, freight prepaid.

Conditions of Sale

Unless otherwise specified, equipment is used, and is sold as-is. All items shipped FOB Tarzana, California. Crystals, ovens, antennas not included unless specifically stated in catalog. All equipment is sold on a first-come, first-served basis.

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Phone: (213) 342-8297

National Standards for FM Operation

By popular demand, 73 presents this page of FM standards as a public service to the VHF community.

2m FM Channels

146.010 S
146.040
146.070 S
146.100
146.130 S
146.160
146.190 S
146.220
146.250 S
146.280
146.310 S
146.340
146.370 S
146.400
146.430 S
146.460
146.490 S
146.520
146.550 S
146.580
146.610 S

146.640
146.670 S
146.700
146.730 S
146.760
146.790 S
146.820 R
146.85 S R
146.880 R
146.910 S R
146.940 R
146.970 S R
147.000 R
147.030 S R
147.060 R
147.090 S R
147.120 R
147.150 S R
147.180 R
147.210 S R
147.240 R

147.270 S R
147.300 R
147.330 S
147.360
147.390 S
147.420
147.450 S
147.480
147.510 S
147.540
147.570 S
147.600
147.630 S
147.660
147.690 S
147.720
147.750 S
147.780
147.810 S
147.840
147.870 S

10m FM Channels

29.020 S
29.040
29.060 S
29.080
29.100 S
29.120
29.140 S
29.160
29.180 S
29.200
29.220 S
29.240
29.260 S
29.280
29.300 S
29.320
29.340 S

29.360
29.380 S
29.400
29.420 S
29.440
29.460 S R
29.480 R
29.500 S R
29.520 R

29.540 S R
29.560 R
29.580 S R
29.600 R
29.620 S R
29.640 R
29.660 S R
29.680 R

450 MHz FM Channels

The 450 MHz FM spectrum is included in the ten megahertz from 440 to 450 MHz. Channels are established at 50 kHz increments throughout. Repeaters are separated by 5 MHz. The upper frequency should be the repeater input; the lower, the output.

6m FM Channels

52.525
52.540 S
52.560
52.580 S
52.600
52.620 S
52.640
52.660 S
52.680
52.700 S
52.720
52.740 S
52.760
52.780 S
52.800
52.820 S
52.840
52.860 S
52.880
52.900 S
52.920
52.940 S
52.960
52.980 S
52.000

53.020 S
53.040
53.060 S
53.080
53.100 S
53.120
53.140 S
53.160
53.180 S
53.200
53.220 S
53.240
53.260 S
53.280
53.300 S
53.320 S
53.340 S
53.630 R
53.380 S R
53.380 S R
53.420 S R
53.440 R
53.460 S R
53.480 R
53.500 S R

53.520 R
53.540 S R
53.560 R
53.580 S R
53.600 R
53.620 S R
53.640 R
53.660 S R
53.680 R
53.700 S R
53.720 R
53.740 S R
53.760
53.780 S
53.800
53.820 S
53.840
53.860 S
53.880
53.900 S
53.920
53.940 S
53.960
53.980 S

220 MHz FM Channels

220.020
220.060
220.100
220.140
220.180
220.220
220.260
220.300
220.340
220.380
220.420
220.460
220.500
220.540
220.580
220.620
220.660
220.800
220.740
220.780
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220.860
220.900
220.940
220.980

221.020
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224.460
224.500
224.540
224.580
224.620
224.660
224.800
224.740
224.780
224.820
224.860
224.900
224.940
224.980

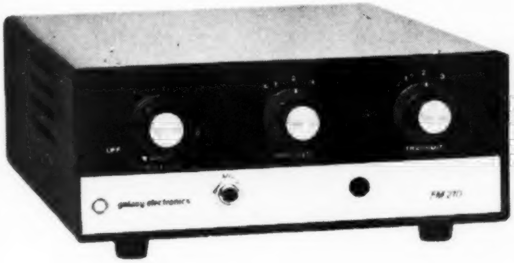
Standard amateur deviation: ±15 kHz. 36F3 emission is recommended on all channels except those channels marked "S". S channel emission is 16F3. Channels marked "R" are RACES frequencies as promulgated by the Office of Civil and Defense Mobilization.

NOW—WORLD RADIO OFFERS YOU A

Fantastic SPECIAL

ON THE TERRIFIC GALAXY FM-210

2 Meter Receiver!



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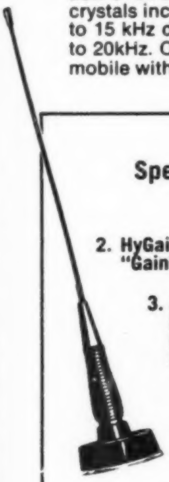
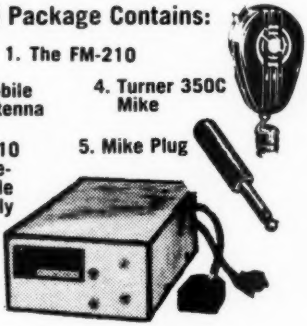
SPECIFICATIONS, FM-210: Terrific – Solid-State Transceiver for 143-149 mHz FM. Independent selection of three transmit/receive positions. 146.94 mHz crystals included. Sensitive FET Receiver accepts up to 15 kHz deviation. Transmit deviation adjustable 1 to 20kHz. Operate direct 12 VDC at 5 watts or fixed/mobile with AC-210 you get 10 watts.



Special Package Contains:

1. The FM-210
2. HyGain Mobile "Gain" Antenna
3. AC-210 Home-Mobile Supply
4. Turner 350C Mike
5. Mike Plug



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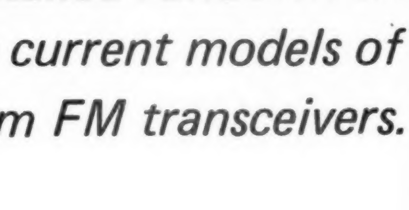
The FM Marketplace

. . .A detailed rundown on all the current models of 2m FM transceivers.

FM's fantastic rise in popularity has brought about a revolution in the ham market, with manufacturers young and old competing for a share of the business. 73 considered publishing detailed product reviews on all the equipment available, but new equipment continues to make the scene at a clip far too furious for reviews to keep pace. As an alternative, we decided to publish "capsule reviews," where all the 2m FM transceivers could be listed together and described in one sequence of pages, thus allowing amateurs to compare price, performance, features, and appearance.

To do this, 73 requested evaluation models of all rigs currently being manufactured. Then, as the units came in, they were systematically checked out and photographed. The specifications were listed and comprehensive descriptions prepared. The following paragraphs represent the results of the lengthy evaluation effort. The 2m FM units pictured and described herein are: Clegg, Drake, Galaxy, Regency, Simpson, Standard, Swan, Telecomm, Tempo, and Varitronics. The reviews also include two portable units – one by Varitronics, the other by Drake.



Standard's new SR-C826M uses a beefed-up receiver borrowed from the company's type-accepted line of marine units. Among other improvements over the early Standards: more rf amplification stages and increased selectivity.

STANDARD

Standard's SR-C826M is a 12-channel transceiver that runs 10W of rf output power, has a receiver sensitivity of 0.4 μV for 20 dB of quieting, and sports an illuminated selector switch and S-RF meter. The transceiver comes from the supplier with 4 frequency positions installed: 146.94 direct, 146.34/146.76, 146.34/146.94, and 146.76 direct. The Standard unit comes from the factory equipped with microphone, mobile mounting bracket, power cable and cord.

The transmitter frequency deviation is preadjusted to ± 7 kHz, a good figure for most of the repeaters in the country; an internal adjustment will vary the level from 0 to 10 kHz. A front panel switch allows selection of rf output power to conserve drain when operating off an uncharged battery. The high-power position is 10W out; the low-power position drops the output to slightly below a watt. In the low-power position, battery drain is about a quarter-amp during transmit. Under normal weather conditions (-10 to +60°C), the frequency drift of the unit is less than 0.001% – depending, of course, on the quality of crystals you use. The SR-C826M is reportedly a drastic improvement over the earlier model (SR-C806M) in terms of selectivity. One of these units was functioning at SAROC as an in-band repeater. Sales price: $339.95 . *Standard Communication Corp., Box 325, Wilmington CA 90744.*

VARITRONICS

The Inoue IC-2F, distributed exclusively by Varitronics, Inc., has 6 transmit and 6 receive channels that can be independently selected with concentric switches. Even though the rig is packed with compact circuitry, the unit is remarkably serviceable, owing to the "swingaway" construction of the subchassis elements. The receiver is rated for 0.4 µV for 20 dB quieting, which has proved realistic. The selectivity is adequate for amateur mobile and base operation, but you won't likely be able to use the transceiver as a functioning repeater.

The Varitronics IC-2F has about the highest packaging density of any transceiver on the market, with more circuits per square inch of volume and less dead-air space inside the cabinet. The large panel meter lights up red during transmit. Unprecedented sales volume has allowed the distributor to drop the sales price recently to $299.

The transmitter uses 18 MHz crystals; the receiver uses 45 MHz rocks. Construction and layout are exceptionally clean. A 5-prong receptacle on the rear of the chassis simplifies interconnection of tone accessories and allows discriminator frequency monitoring via a remote meter. A plug for this is provided with the unit.

The unit comes complete with mike, mobile mounting bracket, power connector/cable, spare fuses, and a mike hanger. Connect 12V and a good antenna and you're on the air with a good 10W of rf. A built-in protection circuit senses high standing-wave ratios and will cut off the transmitter when the value climbs too high, thus saving expensive power transistors. Indirect illumination of the built-in S-RF meter serves as "power" and "transmit" indicators: When the power is on, the meter is lit with an ordinary low-drain incandescent lamp; on transmit, a brilliant ruby lamp illuminates the meter. Provided with comprehensive maintenance/operation manual, 1 year guarantee. Comes with crystals for 146.34/146.94 and 146.94 simplex. Sales price: $299.95 *Varitronics, Inc., 2321 E. University Dr., Phoenix AZ.*

TEMPO

Henry Radio's Tempo FMV transceiver is one of the more compact of the imported units. Housed in a sturdy one-piece metal case, the unit comes with power cable, microphone, and one set of crystals – 146.94 (transmit and receive).

There are 8 positions on the channel selector switch and sufficient crystal sockets for 8 transmit and 8 receive crystals. Cross-wiring for accessing one crystal in several positions is a simple process.

The transmitter section is rated at 10W output, though the 73 test unit actually pumped out 15W into a 50Ω antenna (13.8V input). The receiver sensitivity is rated at 1.0 µV for 20 dB of quieting, but

VHF
TEMPO fmv

The Tempo FM-V import offers an unusual buy in terms of performance-per-dollar-of-investment. At $225, the unit will produce up to 15W of rf, and offers sensitivity, selectivity, and noise immunity comparable to the highest priced transceivers. Though the FM-V has no panel meter, it does contain an internal meter socket that allows monitoring of all stages, including discriminator.

73's test unit did much better (0.6 μV). The selectivity is better than average. Noise immunity is definitely superior.

The transceiver chassis contains a metering socket for monitoring all the transmitter and receiver stages. A 0–50 μA meter can be used for monitoring these functions (including discriminator current), or you can purchase a low-cost test set from Henry that is designed to plug in.

With its 29 transistors, 2 integrated circuits, and 15 diodes, the unit is surprisingly compact; and with all its compactness, the unit is surprisingly accessible for service. It comes with a complete instruction manual that describes tuneup and alignment procedure, photos of the transceiver, theory of operation, parts lists, schematics, and a warranty. Sales price of the Tempo FMV: $249.00. *Henry Radio, Inc., 11240 W. Olympic Blvd., Los Angeles CA 90064.*

SWAN

The FM-2X by Swan Electronics is a 12-channel transceiver with a rated rf output power of 12W. According to Swan, the unit comes factory-equipped for crystals on 146.34/146.94 and 146.94 simplex. 73 has not yet had the opportunity to check out this unit, but the specs are as follows: Harmonics and spurious radiation better than −60 dB; frequency deviation is factory adjusted to ±12 kHz, but may be increased or decreased with integral pot. The receiver is rated at better than 0.6 μV sensitivity at 20 dB quieting. With a dual-conversion superheterodyne circuit, the unit is certain to give adequate selectivity for amateur mobile or base station use.

Swan's FM-2X import boasts a series of 12's: 12W, 12 channels, and factory deviation adjusted to 12 kHz. A large illuminated panel meter and a back-lighted frequency selector make mobile operation an easy chore even at night. The unit operates either direct from the car battery or from 115V ac (for base station operation). Power cords are supplied for ac and dc operation.

The unit sports an easy-to-read, illuminated panel meter for indicating relative power during transmit and relative signal strength during receive. With 28 transistors, 12 diodes, and an integrated circuit, the FM-2X comes complete with power cable (and connector), operating manual, and standard Swan guarantee. Sales price: $229. *Swan Electronics, 305 Airport Rd., Oceanside CA 92054.*

GALAXY

Hy-Gain's Galaxy FM-210 transceiver is all-American. Manufactured in the U. S. with U. S. parts, the unit offers conservative design with plenty of room inside the chassis for mounting tone units or other circuits. With independently controllable transmit and receive frequencies, a great deal of flexibility is offered in terms of selection of operating frequencies (9 possible, with 3 crystal positions for transmitter and 3 for receive.) FETs in the front end serve to enhance sensitivity with a minimum of active devices. Receiver is rated at 1.0 μV for 20 dB quieting. The basic transmitter runs about 3.0W out, but this can be doubled with the optional "power booster" accessory. Crystals for transmit and receive on 146.94 MHz are

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2 METER ANTENNAS FM

NEW FROM THE WORLD'S LEADING MANUFACTURER OF VHF/UHF COMMUNICATION ANTENNAS

(A) FM RINGO 3.75 db GAIN: The most popular — high performance, half-wave FM antenna. Gives peak gain, and efficiency, instant assembly and installation.

AR-2	135-175 mhz	$12.50
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(B) 4 POLE: A four dipole array with mounting booms and coax harness 52 ohm feed up to 9 db gain.

AFM-4D	146-148 mhz	$42.50

(C) FM MOBILE 3 db GAIN: Fiberglass ⅝ wave professional mobile antenna for roof or trunk mount. Superior strength, power handling and performance.

AM-147		$26.95

(D) 11 ELEMENT YAGIS 13.2 db GAIN: The standard of comparison in VHF communications, now cut for 2 meter FM and vertical polarization.

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A449-11	440-450 mhz	13.95

(D) POWER PACK 16 db GAIN: A 22 element, high performance, vertically polarized FM array, complete with all hardware, mounting boom, harness and 2 antennas.

A147-22	146-148 mhz	$49.50

(E) 4 ELEMENT YAGI 9 db GAIN: A special side mount 4 element FM yagi can be fixed or rotated–good gain and directivity.

A144-4	146-148 mhz	$ 9.95

(F) FM TWIST 12.4 db GAIN: A Cush Craft exclusive — it's two antennas in one. Horizontal elements cut at 144.5 mhz, vertical elements cut at 147 mhz, two feed lines.

A147-20T	145 mhz and 147 mhz	$39.50

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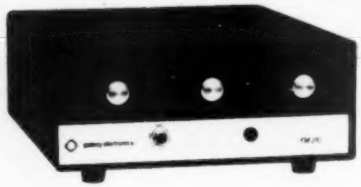


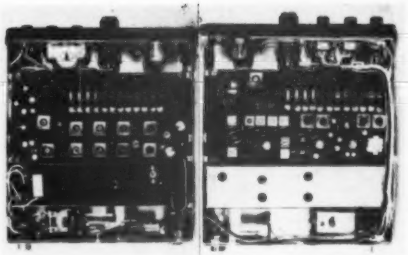
The FM-210 by Galaxy offers 9 channels (3 x 3), easy access for service, and traditional U.S. quality. A power-booster accessory, available at extra cost, increases the value of the FM-210 by upping its output to 35W. This unit has the distinction of being the "American Classic." Like the Ford automobile, Galaxy pioneered the American penetration into an all-import market with this sensibly priced transceiver.

provided. The audio output power is very high quality and the level is sufficient for the noisiest of environments. The microphone input is designed to accept any high-impedance audio input. The transmitter deviation level can be adjusted to any point from 0 to 15 kHz. Plug-in transistors and easy-access circuit boards simplify servicing. Provided with operation manual, full guarantee. Sales price: $229.50. *Hy-Gain Electronics Corp., Box 5407-GL, Lincoln NB 68505.*

TELECOMM

The Telecomm import is a 12-channel transceiver with a rounded two-piece housing, front mounted speaker, and indirectly illuminated S-RF meter and channel selector. Rated at 10W output, 73's test unit actually produced 15W with 13.8V dc input. The front panel sports a unique multipower switch, which changes the output power to 2.5W (medium-power position) or 10 mW (low-power position). The audio quality is particularly clean.

Telecomm, a California company, imports the 10W unit pictured here, but stocks the integral modules as well. The module boards include the receiver, transmitter, and rf power amplifier. The Telecomm has 12 transmit and receive crystal positions, a front-mounted speaker, and three switch-controlled power output levels.



The Telecomm transmit board (left) is accessible from the top of the rig's mobile housing. As shown, the 12-channel board is easily removable. The transmit board drives the rf power amplifier shown at the bottom of the photo at left. Note also the integral hash filter. The receiver portion (right) is accessible from the underside of the chassis.

The unit comes equipped with two sets of crystals (146.34/146.94 and 146.94 direct), and has provisions for accepting power amplifier, tone encoders, remote control circuitry.

The receiver section is rated for 0.6 μV for 20 dB of quieting. Selectivity and noise immunity seem to be on a par with other imports – plenty adequate for amateur mobile or base station operation. Transmitter and receiver oscillators are equipped with trimmers for rubbering crystals to precise channel variations. To ease servicing, the transceiver circuit boards are modular; the transmitter is accessible from the underside, the receiver from the top. The transmitter uses 12 MHz crystals (12X); the receiver, 45 MHz crystals. The i-f lineup is the standard 10.7 MHz/455 kHz arrangement. Comes with schematics and simplified operating instructions. Sales price: $289.95. *Telecomm Electronics, Box 461, Cupertino CA 95014.*

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REGENCY HR-2 FM Transceiver, 2 meter band coverage 144–148 MHz, receiver crystal controlled, sensitivity .35 μV, 20 dB quieting, 6 channel, 10 watt output, all solid state, power supply 13.5VDC self-contained, size 5½W X 2¼H X 7¾D, with high Z ceramic microphone, mounting bracket and crystal 146.94 MHz, price **$229.00.**

CLEGG 22'er FM Transceivers, full 2 meter band coverage 143.4 to 148.3 MHz, receiver is tunable in 100 kHz increments and readable to 25 kHz. Sensitivity .15 μV for 20 dB quieting, squelch threshold less than .1μV. Transmitter rating 55–65 watts DC input, 25 to 35 watts output. All internal circuits broad banded for 4½ MHz coverage. Final amplifier broad banded for ± 500 kHz without retuning. Solid state circuitry with 8150 final amplifier, 9 channel transmitter, 115VAC and 12.6VDC self-contained power supply, size 12½W X 5½H X 11½D, price with PTT microphone and crystal 146.94 MHz, price **$369.95**

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DRAKE

The *Marker Luxury* by Drake represents a sensible compromise in hybridization. Combining a tube-type final with solid-state oscillator, multiplier, and driver stages to give an output signal that exceeds 20W (With an input of 13.8V dc), the transceiver offers a total of 12 channels, compact construction, and excellent overall performance. The receiver section is more selective than most, and can quiet the noise by an honest 20 dB with only a half-microvolt input. A particularly interesting feature of the Marker Luxury is the built-in 115V power supply, which means that the unit can be operated in the car or as a base station with no additional appliances. The unit comes equipped from the factory to transmit and receive on three channels: 146.34/146.94, 146.34/146.76, and 146.94 simplex. Included in the purchase price are the mike, power cords and cables, mobile mounting bracket, coax, and a ¼ wave mobile antenna.

For some reason – probably known only to Drake – the Marker Luxury is extremely conservatively rated. The 73 test unit performed far in excess of the specifications, and earned the Marker Luxury a vote of confidence from the editor, who lamented the incorporation of a vacuum tube in the transmitter before he actually had a chance to try out the radio.

Drake's Marker Luxury is designed as a mobile/base station. An integral supply allows connection to 115V primary power; the supply is bypassed when the unit is connected to a car battery. The Drake unit has a back-lighted channel indicator and an illuminated meter. Crystal positions are provided for 12 each, transmit and receive. Each crystal has an adjacent micro trimmer. Though rated at 15W output, typical Marker Luxury units approach the 20W mark.

The overall construction of the Marker Luxury is similar to that of other Drake units: solid, stable, classy. The design is like the specs – tasteful and conservative. The speaker is front-mounted, and a meter is provided for monitoring rf output during transmissions or signal strength during the receive mode. Sales price: $329.95. *R. L. Drake Co., 540 Richard St., Miamisburg OH 45342.*

REGENCY

Regency's HR-2 is a compact American-made economy model that uses a Motorola 10W transistor in the final amplifier stage. The channel selector is a 12-position switch that allows 6 each transmit and receive channels plus 6 cross-wired channel combinations. The extra-large speaker is mounted facing upward in the one-piece housing. Removal of the speaker gives easy access to all circuits.

Regency's HR-2 is one of the few American-made 2m FM transceivers. Though not the smartest-looking of the units available, there's probably not a unit anywhere that is easier to service. When the extra-large speaker is moved aside, all parts of the HR-2 are easily accessed. The compact transceiver is characterized by design economy and adequacy of performance.

The receiver section is rated for 0.35 μV for 20 dB quieting; 73's test unit did not quite meet this spec – though it did perform within the 0.5 μV figure that is fairly typical of most available transceivers. The transmitter put out 12W with an input of 13.8V when the channel selector was on the 146.94 position, and the power drop-

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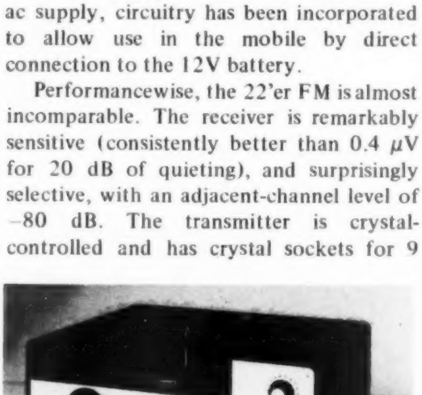
ped to 10W on the 146.34 position. The unit comes with high-impedance ceramic mike, power cable and plug, and transmit and receive crystals for 146.94 MHz. The transmitter crystals have frequency-adjust trimmers, but the receiver does not. A built-in swr "mismatch protection" circuit prevents operation with improperly tuned, open, or shorted antennas. The receiver i-f's are 10.7 MHz and 455 kHz. Receive crystals are 45 MHz types. The transmitter stage uses 6 MHz crystals. Comes with 5½ x 8½ in. operating manual, 90-day warranty, necessary accessories. Sales price: $229. *Regency Electronics, Inc., 7900 Pendleton Pike, Indianapolis IN 46226.*

CLEGG

The Series 25 Clegg 22 FM'er is a radical departure from the traditional, and the manufacturer gambled against heavy bets within the FM fraternity that a tunable receiver wouldn't make it. Clegg wins! Though the unit is designed primarily for base station applications, with its built-in ac supply, circuitry has been incorporated to allow use in the mobile by direct connection to the 12V battery.

Performancewise, the 22'er FM is almost incomparable. The receiver is remarkably sensitive (consistently better than 0.4 μV for 20 dB of quieting), and surprisingly selective, with an adjacent-channel level of −80 dB. The transmitter is crystal-controlled and has crystal sockets for 9 channels. The Series 25 receiver dial is calibrated in standard-channel increments of 60 kHz, with minor markers at the 30 kHz channel points. Reports from users of the 22'er generally state that the dial accuracy is extremely close; silent channels can be selected with precision, and no tuning is required to make sure you're really monitoring the right frequency.

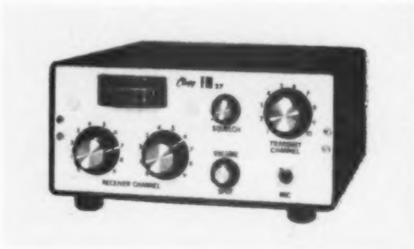


The Clegg 22'er uses vacuum tubes in the final to produce more power output than any of the available transistor rigs. The tunable receiver is calibrated to mark existing FM channels. The transmitter section is crystal-controlled, and runs approximately 35W out. The receiver section is highly selective and as sensitive as they come. Unit operates from 115V ac or 12V dc.

The transmitter runs about 30W output, though this figure varies from unit to unit. Some reports have indicated outputs of up to 40W. The receiver and most transmitter stages are fully solid-state; the transmitter final is a tube. Design is clean; the knobs have that "executive feel." Sales price: $384.95. *Clegg Associates, Inc., Littell Rd., East Hanover NJ 07936.*

CLEGG SYNTHESIS

One of the most important developments in the FM era – indeed, perhaps THE most important – is the successful manufacture and marketing by Clegg Associates of the FM 27, a transceiver that incorporates a fully frequency-synthesized receiver section. To monitor a specific frequency, the operator merely sets the two receiver controls to the numbers corresponding to the 146 MHz channel. To monitor .94, the operator sets the first control to 9, the second one to 4. In the photo, the receiver is set to monitor .76. The beauty of this approach is that any one of 100 possible channels can be monitored with crystal accuracy – but without the need for crystals. And even such off-breed nonchannels as .80 and other sometimes used nonstandard frequencies



Clegg's FM 27 has one fantastic feature that tops all others: The receiver is a synthesis type, meaning that the operator can "dial" any channel he wishes to monitor by merely setting up the channel numbers on the two controls.

DyComm MINI

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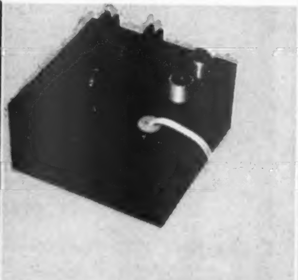

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5–15W IN,
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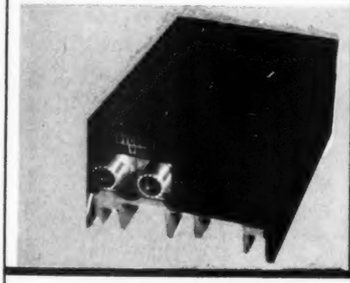

101-500E
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SPECIAL

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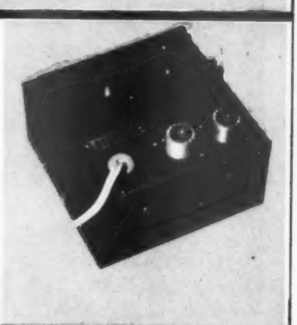

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8–10W IN,
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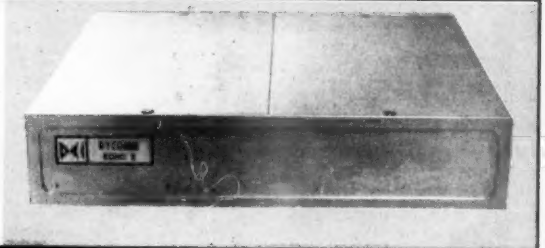

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can be monitored, as long as the channels are multiples of 10 kHz between 146 and 147 MHz.

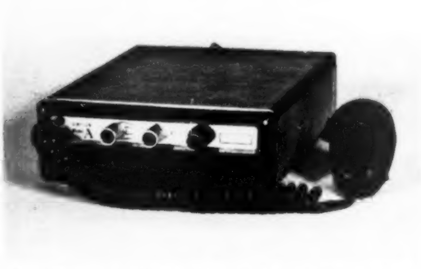
The transmitter portion of the transceiver is the 10-channel version from the company's 22'er model. The transmitter puts out about 30–35W of rf, and is said to be exceptionally stable. The design is clean, as it is with all Clegg units. As can be seen in the photo, accent is on simplicity and ease of operation.

Though 73 has not had the opportunity to evaluate one of these units (they're just out at this writing), the manufacturer's specs look very promising. The selectivity of the receiver is rated at 80 dB of adjacent-channel attenuation. The sensitivity figure is rated at 0.25 μV for 20 dB of quieting.

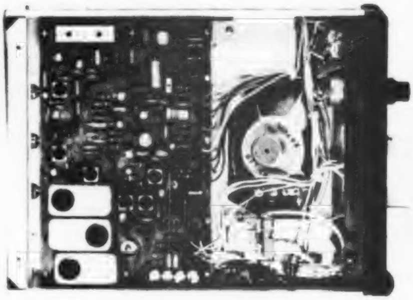
SIMPSON

Simpson's Model A FM transceiver steps into amateur radio from the nearby VHF FM marine band, where it has been – and still is – serving boat owners and yachtsmen. The Model A's rugged construction is probably attributable to this heritage; the rig is built like a battleship, and from first appearances one might guess that nothing could damage it.

Although a smidgen larger than most of the other solid-state 2m FM units, the Model A's power output is slightly less than average – about 7.5W at 13.2V dc input. This rig's big plus is its serviceability; the circuit boards are laid out in such a manner that virtually every stage of both the transmitter and the receiver sections are easily accessible for repair should the need arise.



The Simpson Model A transceiver is one of the few that have received FCC type-acceptance for operation on the adjacent marine band. This durable FM unit has removable top and bottom cover plates that give easy access to internal circuitry. Sufficient volume exists inside the housing to mount tone units or other add-on circuits.



As can be seen in this view of the Simpson, the tuned circuits are all enclosed in shielded metal housings, and the trimmers are all of the air-variable variety. A very large speaker, mounted in an acoustical chamber, is capable of coupling several watts of audio into the air. Active devices of the Model A include several integrated circuits.

Two channel-selector switches adorn the front panel of the Simpson Model A – one for the receiver, the other for the transmitter. With four channels transmit and four channels receive, the total number of transmit/receive combinations are 16.

The Model A comes with crystals for operation on .94 (direct) and .34/.94. Other factory equipment includes power cable and connector, push-to-talk microphone, fuse, mike hanger, mounting hardware, and an operation/maintenance handbook.

The unit houses an extra-large speaker housed in a clever acoustical chamber that supplies very loud and crystal clear audio under adverse conditions of a noisy environment. Receiver sensitivity is about 0.5 μV for 20 dB of quieting, and the selectivity is –60 dB at 36 kHz. Sales price: $245. *Simpson Electronics, Inc., 2295 NW 14th Street Miami FL 33125.*

HANDIE-TALKIES & PORTABLES

DRAKE TR-22

The TR-22 is a very compact transceiver that can only be classed as a "portable." With the general shape of a conventional mobile transceiver and the size of 1½

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Dept. 73

late-model hand-held units, the little rig runs a watt and a half of rf out into its own integral telescoping whip antenna. The rig is set up to do triple duty – as a handheld unit, a base station, and a mobile.

For hand operation, the unit sits in its leather carrying case with shoulder straps. The slim "pencil" microphone connects to the transceiver through a curly cord, and the telescoping whip extends from the face of the unit. An internal pack of "penlite" rechargeable Nicads supplies 12V to power the rig. The case is easily removeable (without tools), but provides a splashproof housing for the transceiver and its speaker.

As a mobile, the unit can be connected under the dash. A standard UHF connector is provided on the rear panel of the chassis along with a connector for accepting battery voltage. A mating connector and power cable are furnished with the TR-22.

As a base station, the unit becomes operable by connecting a 115V power cord between the unit and household power. (The proper cable, resembling a TV "cheater" cord comes with the transceiver. A unique accessory is available that includes an rf output amplifier and a receiver preamplifier (AA-22, $149.95, 25W).

Operationally, the TR-22 has 6-channel capability, and cross-wiring is easy. The receiver checks out at 0.5 μV for 20 dB quieting. Selectivity is fair: noise immunity is average. For quality of overall package, and construction/layout, the TR-22 rates an A+. $199.95. *R. L. Drake Co., 540 Richard St., Miamisburg OH 45342.*

As a portable unit, the TR-22 operates from its own self-contained batteries. A carrying case and shoulder strap are provided with the unit, as is the pencil microphone with its curl cord. Power output is between 1.1 and 1.5W, depending on condition of batteries.

The TR-22 is about half the size of the smallest mobile units, and includes virtually all the performance features of the big rigs while retaining that elusive ingredient called portability. The unit has 6 channels, independent squelch and volume controls, and a panel meter to indicate the capacity of the integral batteries. The unit is powered from an internal battery pack, external auto battery, or 115V ac. In addition to the front-mounted telescopic whip, the unit has a conventional UHF connector on the rear to facilitate operation as a mobile or base station.

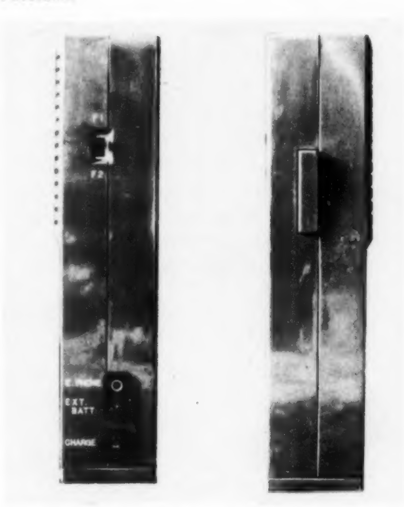
As a mobile unit, the TR-22 fits easily under the dash of even the most compact car. It connects directly to the car battery and an external antenna. The speaker is splash-proof, and the unit can be removed from the case without tools; two unique push clips hold the unit in its one-piece housing.

VARITRONICS HT-2

The HT-2 hand-held 2 meter transceiver is the only "handie-talkie" currently being marketed specifically for the amateur market. Amateurs interested in small packages and big performance should not overlook this sleeper. This unit was tested more thoroughly by 73 staff than any other FM transceiver, because it seemed to be too good to be true. The transmitter pokes out 2W, and the signal is good, clean, and stable. Early units had bassy audio, but recent models sound almost hi-fi. Deviation level on the transmitter is factory adjusted to about 10 kHz, and can be easily set to any requirement by pot adjustment.

The selectivity of the receiver is adequate, nothing more. But the sensitivity is unbelievable – 0.4 μV or better for 20 dB of quieting. It's something you'll have to measure for yourself to fully appreciate.

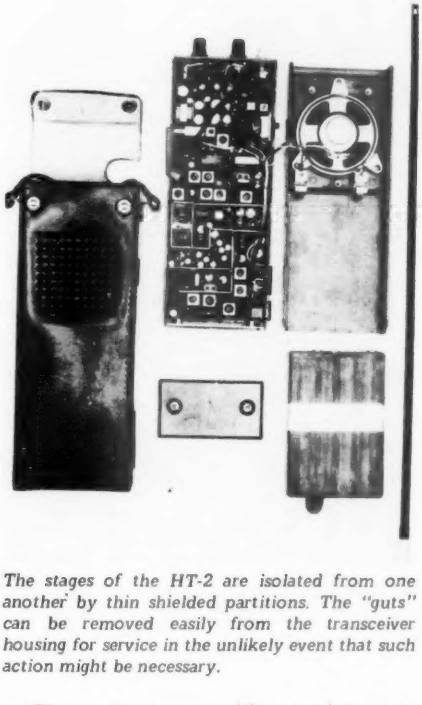
The package is definitely not Motorola quality even though the performance is. And even the plain packaging can be appreciated if you have to work on the unit. The whole thing comes apart to reveal well laid-out, easily serviceable stages, each well shielded from the other by metal barriers.



Varitronics' HT-2 is a 2-channel, 2W hand-held transceiver that comes with nicad batteries, carrying case, battery charger, and crystals for .34/.94 and .94 direct. Sensitivity of the receiver section is 0.4 μV for 20 dB of quieting.

OFF
VOLUME
OFF
SQUELCH

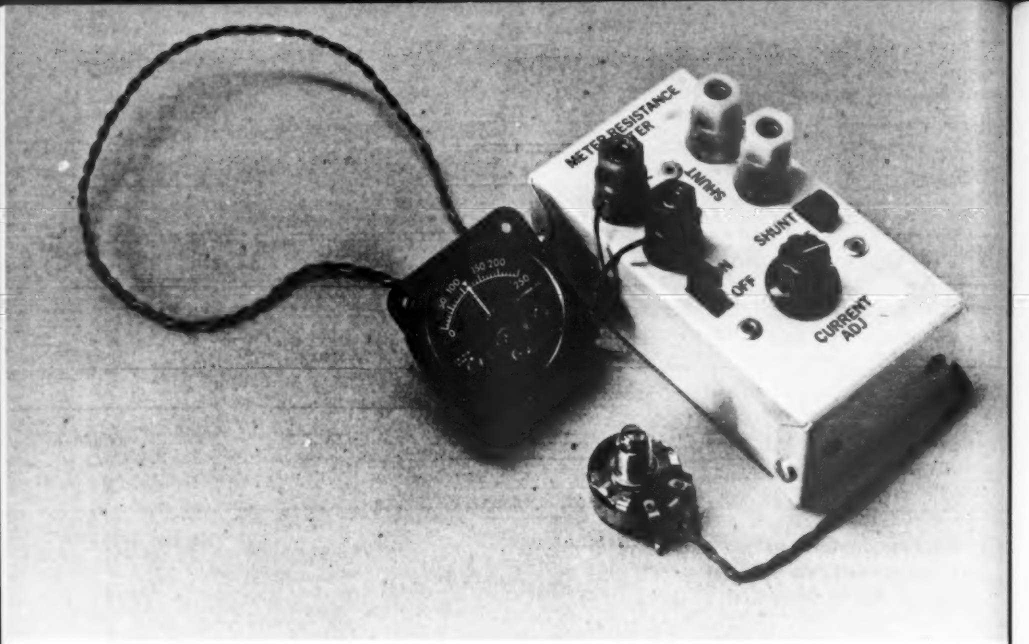
The top of the HT-2 contains on-off and volume control, squelch control, a BNC antenna connector (which also mates to the antenna supplied with the transceiver), and a battery-level indicator.



The stages of the HT-2 are isolated from one another by thin shielded partitions. The "guts" can be removed easily from the transceiver housing for service in the unlikely event that such action might be necessary.

The unit comes with carrying case, leather strap, earphone, nickel-cadmium batteries, and a charger. A top-mounted meter tells the state of charge of the battery at all times the unit is turned on. The antenna (also supplied) mates with a BNC connector on top of the unit itself. Sales price: $249.95. *Varitronics, Inc. 2321 E. University Dr., Phoenix AZ.*

. . .Staff ■


METER RESISTANCE TESTER
SHUNT
SHUNT
ON
OFF
CURRENT ADJ

THE METER EVALUATOR

Meter resistances may not always be as they seem. . .

To the serious experimenter, one of the most useful electronic components is undoubtedly the ordinary meter, and in an effort to obtain more precise measurements, an increasing number of hams are turning to the moderately priced surplus and imported units now appearing on the market. As any experimenter knows, however, with such a wide variety of types and styles available, it is virtually assured that no matter what the intended application, the available unit will always have the wrong range. To use such a meter, then, it is usually necessary to construct a shunt or a multiplier; and this, in turn, requires a

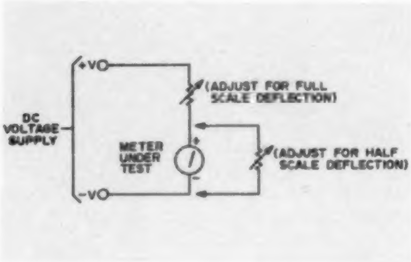
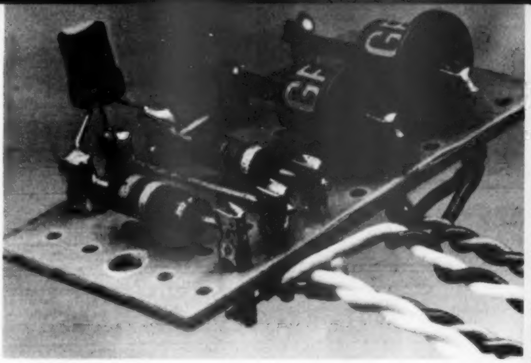

+V
(ADJUST FOR FULL SCALE DEFLECTION)
DC VOLTAGE SUPPLY
METER UNDER TEST
+
−
(ADJUST FOR HALF SCALE DEFLECTION)
−V

Fig. 1. Standard circuit for measuring meter resistance.

Circuit board of the meter evaluator. The twisted pairs go to: shunt switch and R_X binding posts, METER binding posts, battery and current switch, and R3. (Photo by Dale J. Ritter.)



knowledge of the meter's internal resistance. Since this parameter is rarely specified on the meter itself, it further becomes necessary that the experimenter be able to measure it as accurately as possible. In this respect, it is sad to say, conventional techniques leave a great deal to be desired.

It often comes as a surprise, particularly to those who wind their own shunts and who trust their meters, to learn that by using one conventional technique, it is entirely possible for readings to be off by as much as 50% or more! Obviously, the accuracy of the method by which internal resistance is measured must be carefully considered, since the usefulness of the meter depends upon it. The purpose of this article is to examine the error incurred by the standard technique for measuring meter resistance, and to suggest a method which will overcome its limitations.

Measuring Meter Resistance (The Old Way)

The standard method of measuring internal resistance, covered in virtually every text on dc measurement, is the familiar two-resistor technique of Fig. 1. The circuit is discussed in the *Radio Amateur's Handbook* and the explanation given of how it works is fairly typical: The meter to be measured is connected in series with a stable dc voltage and a variable resistor, adjusted to produce full-scale deflection. A second resistor is then shunted across the

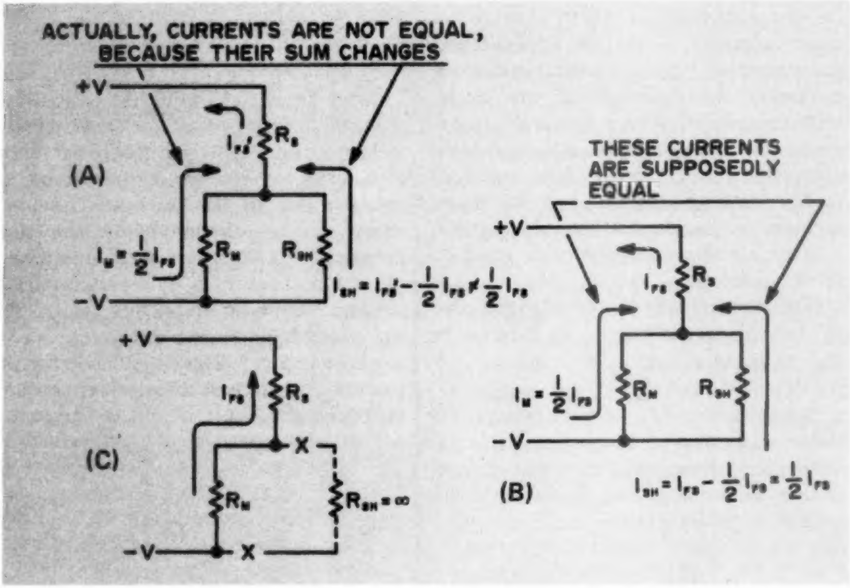
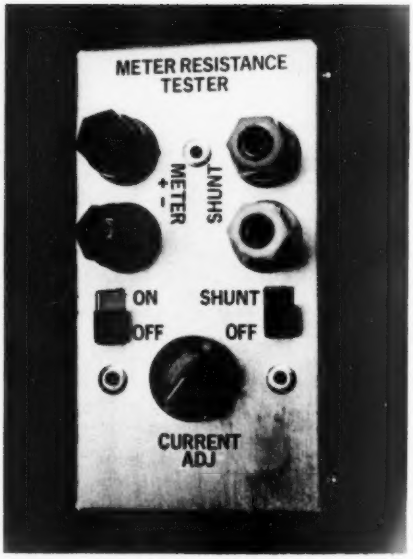

ACTUALLY, CURRENTS ARE NOT EQUAL, BECAUSE THEIR SUM CHANGES
+V
I_FS'
R_S
(A)
I_M = 1/2 I_FS
R_M
R_SH
I_SH = I_FS' − 1/2 I_FS ≠ 1/2 I_FS
−V
+V
I_FS
R_S
X
(C)
R_M
R_SH = ∞
−V
X
THESE CURRENTS ARE SUPPOSEDLY EQUAL
+V
I_FS
R_S
I_M = 1/2 I_FS
R_M
R_SH
−V
(B)
I_SH = I_FS − 1/2 I_FS = 1/2 I_FS

Fig. 2. The two-resistor technique. (A) R_{SH} disconnected and R_S adjusted for full-scale deflection. (B) What supposedly happens when R_{SH} is reconnected. (C) What actually happens! Note that I_M and I_{SH} are not equal if I_{FS} changes.



Front view of meter evaluator. (Photo by Dale J. Ritter.)

meter and adjusted to produce a deflection of half scale. At this point, it is claimed, the meter resistance is exactly equal to the shunt resistance, so that by disconnecting and measuring the shunt resistance one can determine the resistance of the meter. Unfortunately, that's not always the way it works out. The method is very widely used; it's cheap, simple, fast, and uses readily available junkbox parts. But it can also lead to considerable error; to see why, let's examine the operation of the circuit a little more closely.

The problem may be put in perspective by considering the circuit as redrawn in Fig. 2. In A, with R_{SH} disconnected and R_S again adjusted for full-scale deflection, a total current I_{FS} flows through the meter, and adjusted to produce half-scale deflection (sketch B), the total current divides between the two branches. If the total current is I_{FS}, then

$$I_{SH} = I_{FS} - ½I_{FS} = ½I_{FS}$$

and therefore the currents are equal. Since the voltages across the meter and shunt resistances are also equal (they're connected in parallel, remember) it is obvious that their resistances should be equal. This situation is illustrated in sketch B of Fig. 2.

Is this what actually happens, however? No, it's not; let's look at the circuit again: The total current flow, we said, was I_{FS}, and that was certainly true before we connected R_{SH}.But how do we know that it is true afterward? The answer is, we don't – and that's precisely the catch: the addition of R_{SH} in fact *changes* the total current because it changes the total circuit resistance. The shunt current still represents the difference between the meter current (still $½I_{FS}$) and the total current, but if the total current no longer remains equal to I_{FS} and changes to some new value, say I_{FS}', then the shunt current will be given by

$$I_{SH} = I_{FS}' - ½I_{FS}$$

which is not necessarily equal to $½I_{FS}$ (sketch C). In other words, when R_{SH} is connected and adjusted to produce a half-scale deflection, the currents I_M and I_{SH} are not necessarily equals, so that the meter and shunt resistances are not necessarily the same.

What Now, Boss?

After having uncovered the basic cause of error in the two-resistor measurement technique, our problem is how to get rid of it. The inaccuracy, as we have seen, is basically due to the fact that the total circuit current – the sum of the meter and shunt currents – changes with the addition the shunt. Seen from this perspective, a solution is obvious: simply feed both meter and shunt from a constant-current source, as shown in Fig. 3. This situation, in fact, is precisely what one obtains by greatly increasing the value of R_S, as suggested

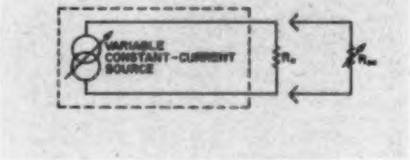


Fig. 3. A constant-current source is used to measure meter resistance.

earlier. One problem with that approach, already pointed out, is that it's difficult to know just how much to increase it without knowing the meter resistance itself. A second problem is that in order to maintain a constant current, any increase in R_S necessitates a corresponding increase in the supply voltage. A variable high-voltage supply designed to deal with these difficulties is certainly not impossible to build, but it is really a rather cumbersome way to handle the matter in view of the fact that a much more elegant solution is available.

. . .Finally!

Since all we need to measure internal resistance with accuracy is a simple "black box" constant-current source, the contents of the "box" is immaterial, and any old circuit will do. One simple but effective approach is the circuit of Fig. 4, a modification of the one-transistor source commonly used in linear ICs.

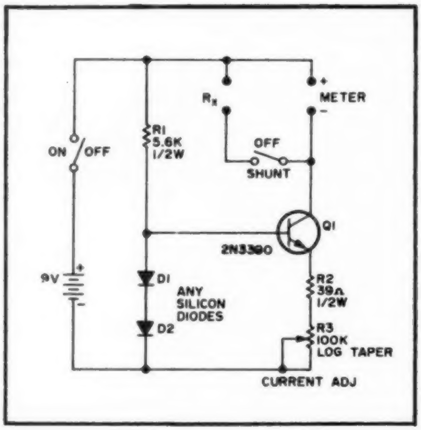
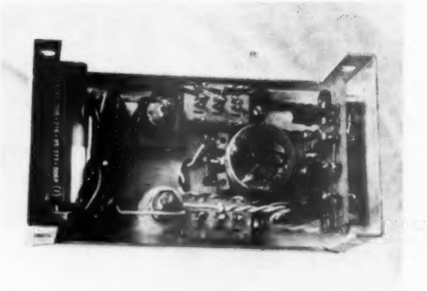


Fig. 4. The meter evaluator, a practical and accurate circuit for measuring internal meter resistance.



Interior view of meter evaluator. (Photo by Dale J. Ritter.)

Diodes D1 and D2 in the circuit act as voltage regulators, their intrinsic standoff potential being used to supply a stable voltage to the base of transistor Q1. Q1's beta should be as high as possible so that fluctuations in base current, due to variations in collector load resistance, do not significantly affect the base voltage. A GE 2N3390 or 2N3391 was selected as having the highest beta of any small-signal transistor known to this author (400 and 250, minimum, respectively), and their prices (90¢ and 61¢) are not unreasonable either. To further insure the stability of the base voltage, R1 should be chosen so that the current through D1 and D2 is large enough to swamp out any fluctuations in base current. If the bias current is small, the collector and emitter currents will be approximately equal, and if D1, D2, and Q1 are all silicon units, both will be given by

$$I_C \approx I_E \approx \frac{.65}{R_E}$$

where R_E, the emitter resistance, is the sum of resistors R2 and R3. In my own prototype, R_E is adjustable from 39Ω to 100 kΩ, which produces a current range of about 8μA to 13 mA – sufficient to measure most dc meter movements. The small parts are mounted on a 1¼ x 3/4 in. rectangle of Vector board, and the entire unit is housed in a 4¼ x 2¼ x 1½ in. aluminum minibox (Bud CU 3016A). The arrangement is convenient and compact, but otherwise the wiring is not critical.

To use the meter evaluator, connect the meter and shunt to the appropriate binding posts, then turn on the current and turn off the shunt switch. Rotate CURRENT ADJ until the meter reads full-scale. Flip the shunt switch to SHUNT and adjust the shunt resistor until the meter reads half-scale. The shunt resistance is then *really* equal to the meter resistance, and may be disconnected for measurement.

...Marovich■

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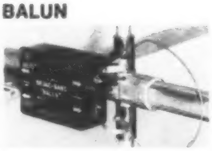

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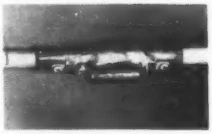

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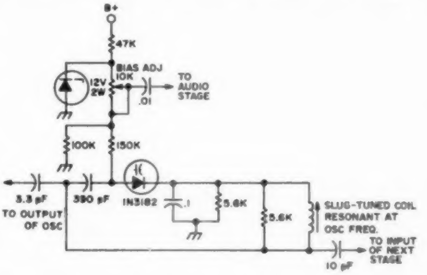
a simple varactor modulator for going FM

In the past few years, FM has become the big thing in amateur radio. It offers dependable, noise-free communication to thousands of hams around the country. If you have an old AM-type VHF transmitter, you can join right in with the rest of the guys who have discovered FM too, for only a few dollars. A simple add-on phase modulator can be used with any type of transmitter regardless of crystal or vfo control, because it varies the frequency indirectly by varying the phase of a tuned circuit.

The phase modulator has been around for years in commercial FM equipment in the form of a tube-type circuit that is still used today in some of the larger fixed commercial stations. A newer type of circuit shown here utilizes the varactor, a semiconductor device that can vary its capacitance by varying a bias voltage. This device is very practical for use as a phase modulator circuit because of its small size and low power requirements. The phase modulator is installed in the transmitter circuit betweeen the oscillator and the subsequent stage.

After the phase modulator circuit is installed, tune coil L1 to resonance at oscillator's operating frequency by tuning for maximum output. Then, tune the bias adjustment for best distortion characteristics.

It is also helpful to install a transmitter preemphasis circuit, although it is not actually needed. A preemphasis network is an RC circuit in which, by the reactance of a low-value capacitor, the high frequency audio is emphasized as compensation for unequal audio amplification characteristics, producing a better noise rejection pattern. As the reactance of the capacitor decreases with frequency, more of the higher frequency audio is passed through. In an FM receiver, however, a deemphasis unit deemphasizes the high audio tones back to their original form.



A lower value of the .01 audio coupling capacitor produces more preemphasis, and more capacitance produces less. If you can't dig up a 100 kΩ resistor, any high resistance will do.

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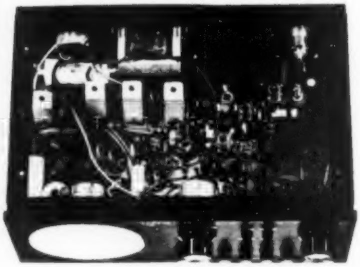


As the number of repeaters grows, the active FM amateur finds that he wishes to listen to more than one channel at a time. The initial piling up of repeaters on 146.34/.94 has been giving way to a spreading out to other less active FM channels.

The obvious answer to the problem of listening to more than one channel at once is a scanning receiver. This is a lot simpler than buying or building a whole set of receivers, each tuned to a repeater channel. A scanner has an electronic switch that lets it tune to a series of channels, one after the other. As soon as it comes to one with a carrier on it the scanning stops and the receiver squelch opens up.

In the area where 73 Magazine is located there are nine great repeaters. Imagine, if you can, trying to switch from one to the other of all these. Three of the repeaters have 94 outputs, so all we need are seven scanning channels to hear all nine repeaters. The Electra Bearcat scanner has eight channels so we set it up to check the nine repeaters plus a .34 channel for copying local calls on the repeater input channel.

Now, whenever anyone comes on any repeater, we hear what is going on and can see the light on the scanner indicating what channel is busy. Once you try this system you quickly decide that this is the only way to fly.

The Bearcat has a provision for screwing in a collapsible vertical antenna if you are using it for portable monitoring or are in a strong signal area. You can plug in your station antenna for added sensitivity. It runs from either 12V dc or 115V ac, so you can use it at home or in your car.

There is a small slide switch under each of the eight channel lights enabling you to have the scanner omit any of the channels that you don't want to check. This is handy when, say, .94 is tied up with some long-winded chaps and you don't want to just sit and listen to them by the hour. You flip off .94 and the scanner checks all the other channels except .94.

The scanning mechanism may be turned off and the receiver will then monitor any single channel you desire.

Someday, in the distant future, some transceivers will probably include a scanner like the Bearcat. It may even automatically switch the transmitter to the appropriate channel for the repeater being received. In the meantime, there is the Electra Bearcat at just under $140, and it sure helps to make FM a lot more fun.

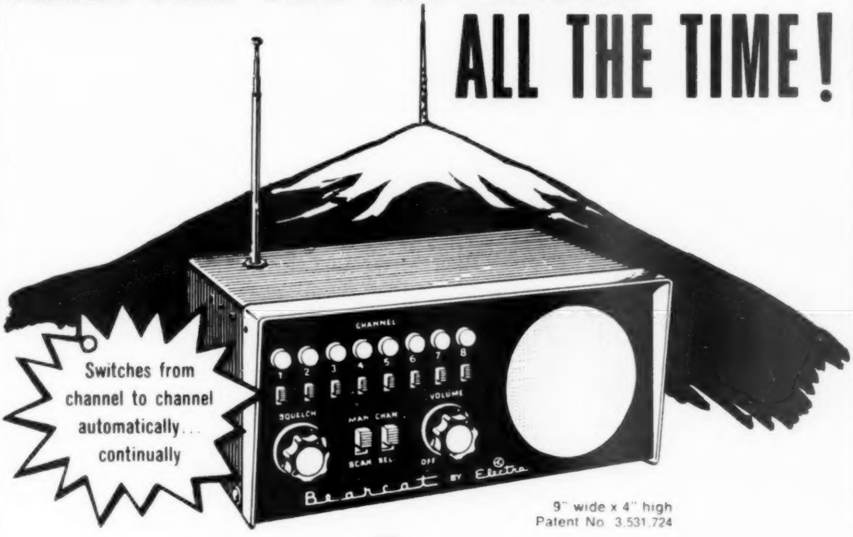
The Bearcat was originally designed as a VHF receiver for scanning fire, police, and other services using FM. The receiver easily tunes to 2 meters, so it was a natural for scanning 2m FM repeaters.

The receiver is a lot more elaborate than you might suppose. It is built on a printed circuit board and is apread out well enough to permit easy servicing. There are 23 transistors and six integrated circuits. Individual transistors are used for each of the eight crystal oscillators. ICs do the scan/switching.

Now 73 staff members take the Bearcat along on trips, permitting the FM bands to be scanned for activity wherever they go. Much of the activity would certainly be missed without this scanner.

. . .Staff■

HEAR ALL THE REPEATERS ALL THE TIME!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4
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For many years the Measurements Corporation Model 80 signalgenerator has been the industry standard for tuning rigs. Many hams have wanted to have a laboratory-grade signal source of this type but the $800 price tag is prohibitive. This article describes a signal source that has many of the same features as the 80 except that it only costs 1% as much. That's why I call this the Model 0.8.

You wonder at some of the features of the marvelous little device? To briefly list them, it has:

- Variable output from about 80 nV to 50 mV of rf power.
- Frequency range from 1.8 to 450 MHz so you can cover 160 through ¾ meters.
- Crystal-control frequency stability.
- Fairly clean output signal.
- A 51Ω antenna load.
- Safety feature to prevent the destruction of the device in case a transmitter is accidentally loaded into it.

The Circuit

The circuit is the combined brainchild of many ham engineers and technicians in our local 2m FM club – the Toronto FM Communications Association. More than 300 of these units have been built in the past two years, so the circuit has been exceptionally well tested in the field.

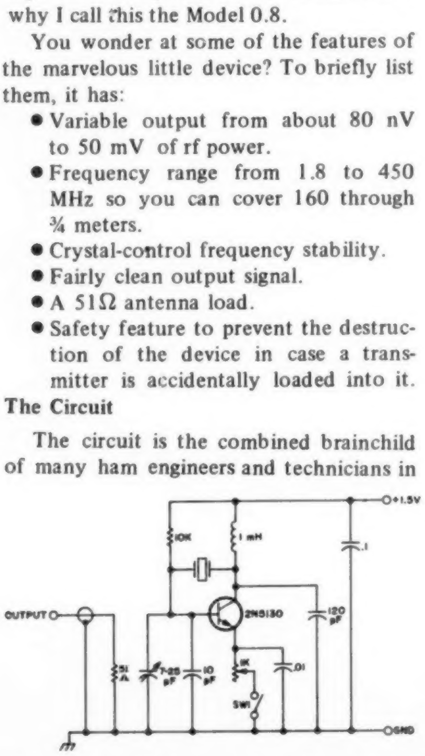

Fig. 1. Schematic diagram of the "Point Eight" Signal Source, the "poor man's Model 80."

The unit consists of a single 2N5130 NPN transistor oscillator configuration. Other transistors, such as the 2N706, can be used in this circuit with slightly different biasing arrangements; however, the 2N5130 appeared to give the cleanest output signal.

Output level can be varied from less than 80 nV (the best we could measure) to 50 mV. It is controlled by a 1 kΩ pot in the transistor collector circuit. Power is obtained from a 1.5V penlight cell bypassed for rf by a 0.1 μF capacitor.

My present "0.8" signal source has been used intermittently for more than a year without any degradation of output. However, remember to shut the unit off when you're finished with it; the battery doesn't last forever.

The unit is built on a PC board. The parts layout is almost exactly the same as that of the schematic shown in Fig. 1. The electronic components are placed on the copper side of the board. The on-off switch-level control, frequency adjustment, output jack, and crystal socket are on the other side (Fig. 2). The unit can be packaged in a minibox.

Almost any crystal in the 1.8–12 MHz will oscillate in this unit. The output is rich in harmonics to 450 MHz, so you can tune up any receiver from 160 to ¾ meters.

The output impedance of the signal source is 51Ω, a value which simulates a perfect antenna load to the receiver. This is the manner in which this is accomplished: A 51Ω, ½W resistor is connected across the terminals of an RCA phono jack. No physical connection is made to the circuit except through the common ground of the PC board. The maximum output level depends on the lead lengths of the resistor. (The unit has plenty of output when the lengths are about ½ in. long.) This design has an added safety feature, too; if by accident you load a

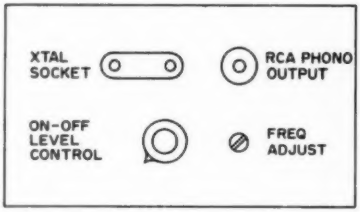

Fig. 2. Minibox layout of the signal source panel.

transmitter into the unit, all that is destroyed is the ½W resistor.

Operation and Uses

These units were originally designed to tune up 2m FM receivers. The procedure is quite simple. You connect the signal source to the antenna input on your receiver. Plug in a transmit crystal, and adjust the frequency control for a zero reading on the discriminator. Adjust the output level to the desired signal strength (below first limiter saturation) and tune up the receiver.

There are a myriad of other uses for the signal source. Using a 3.5 MHz crystal, you have a band edge marker. With the transmit crystals on a Twoer or any other transmitter you have instant frequency spotting without modifying the circuit of the transmitter. Of course, the signal source can be used to tune up any receiver, peak tuned circuits, be an rf source for an antenna noise bridge, and so on.

How to Get Yours

There are two ways to get the 0.8 signal source. The first is to make your own. If you have a well stocked junkbox, I suggest you do this. The second method is to take advantage of our club's assembled, tested, and guaranteed signal sources. By virtue of free labor, volume purchasing, and free parts donations from hams who are big wheels in their respective companies, we are able to produce the units for $8 postpaid anywhere. The units are available from the Toronto FM Communications Association, Box 427, Willowdale, Ontario, Canada.

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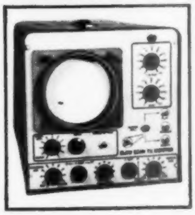

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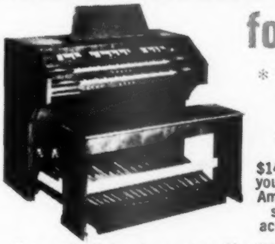

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even more on touchtone

Touchtone has become very popular lately for a variety of signaling applications. FM repeater users, for example, have found this to be a particularly useful means for controlling a variety of repeater functions as well as for dialing through an autopatch.

The basic sending units, or pads, as they are commonly called, and decoders are available not only through surplus channels, but can be purchased new at prices which are reasonable for most hams' pocketbooks. One source of new pads is Automatic Electric Co. of Northbrook, Illinois. Their Touchtone pads are available in single lots for approximately $25. Touchtone signaling is also used for many computer and data transmission applications, and already some equipment from these fields is becoming available through the surplus channels.

Once you get a Touchtone pad, however, either new or surplus, the next problem is how to hook it up. The majority of pads available have been designed for telephone use, and have an overabundance of lead wires. Depending on the type you get, there may be 7 to 11 leads coming out of it. The number of leads, incidentally, has no relation to the number of buttons on the pad. Some of these leads are used in a telephone set to short out or attenuate signals to and from the handset through a set of switch contacts on the pad. Also, since the induction coil in the telephone set is sometimes used as part of the connection, there are even more leads to contend with.

It is possible to make a pad work with only two leads, plus and minus. The schematic of Fig. 1 shows one such connection scheme that I have successfully used on an Automatic Electric pad. It is my understanding that the Western Electric and Automatic Electric pads are identical in their external connections. When connected as shown, the pad will work with as little as 3V applied. The leads shown are the only ones of importance, and if your pad has other leads which are not shown on the schematic, they can be ignored. One exception would be if you have a violet lead and a green-white lead on an 11-lead pad; these are connected to an internal set of normally open contacts which close whenever any button is depressed. These leads can be used to key a push-to-talk, battery, or other line. With the hookup of Fig. 1, the Touchtone pad can be plugged directly into a carbon mike input circuit, and it will work without any other power requirement, since the microphone current source will usually be sufficient to power the pad. With a dynamic mike or crystal mike input, however, an external power source, load resistor, and blocking capacitor must be used, as shown in Fig. 2.

How about testing one of these pads, now that you have it working? Well, if you happen to live in an area where the phone company offers Touchtone service (even if you don't have this service yourself), then your local phone company probably has a device available that you can use. First, hook the leads on the pad together per Fig. 1. Then dial up the

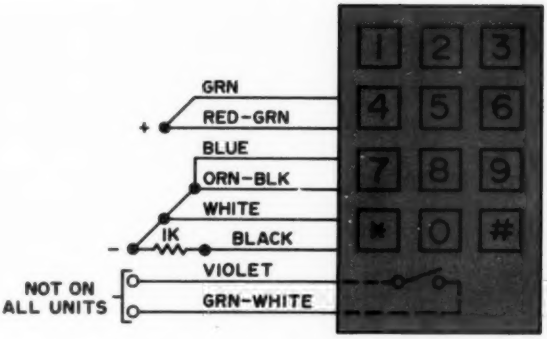

Fig. 1. Two-wire conversion.

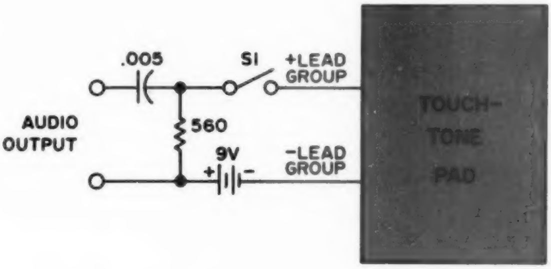

Fig. 2. Connections for use with non-powered mike inputs. S1 may be internal switch through violet/grn-wht leads if provided. Otherwise S1 is external SPST power switch.

ringback number for your phone. In many parts of the country, this number is 981- or 982- plus the last four digits of your own phone number. For example; your phone number is 234-5678 – the ringback would be either 981-5678 or 982-5678. You will get either a busy signal (in which case try the other prefix) or a second dial tone. If you get the second dial tone you have been successful in reaching the Touchtone tester. Being sure to observe the proper polarity, connect the pad directly across the phone line (red and green wires) and depress 1 through 0 in sequence. If the frequency and level of the tones reaching the central office are within the acceptable limits, you will be rewarded with two short bursts of tone. If they are incorrect, or you missed any one of the buttons, after 15 seconds you will hear one short tone burst. With a twelve-button pad, the test sequence is still the same. The # and * character buttons may be depressed, but they will not affect the outcome of the test. The dial tone will remain on during the entire test, so don't be misled by the fact that it does not go away after you depress the first digit button. Also, don't be disappointed by the fact that you can't use the Touchtone pad on your phone to dial; you can't unless the central office equipment has a Touchtone decoder for your line. Be sure to disconnect the pad from across the line *before* you hang the phone up as the line voltage will rise to 48V with the phone on the hook and could damage the pad.

This ringback number is also used by telephone installers to make a phone ring back. If you should depress the hookswitch momentarily or dial a 1, a second dial tone will change to a 1000 Hz tone, and another dialed 1 or hookswitch depression will cause the phone to ring when it is hung up. In case the 981- or 982- prefixes do not work in your area, a call to repair service or a talk with an amiable telephone installer could probably get you the information required in order to access the ringback and test number.

. . .W1IRH

A SOLID-STATE PRESELECTOR

Carl C. Drumeller W5JJ
5824 N W 58 St
Warr Acres, OK 73122

There are many receivers now on the market and a great many used receivers that can have their performance improved significantly by the addition of a preselector. Such receivers are the ones to which a beginner is attracted by consideration of price.

These receivers usually share such characteristics as lack of stability, lack of selectivity, and lack of ability to reject images. (Sometimes this last-named characteristic is linked to a high inherent noise level.)

Stability usually is a matter of basic electrical and mechanical design and is not often amenable to corrective measures. Selectivity sometimes can be enhanced by the addition of a Q-multiplier or a crystal receiver. By using solid-state active components, a preselector can be constructed as a single, self-contained unit. Such a unit can be added to a receiver without modifying or in any way lessening the resale value of the receiver, an important consideration for one who intends to upgrade his station equipment by swapping or trading in.

What is desired of a preselector? Here are 10 points I believe to be pertinent:

1. Selectivity for rejection of images (not necessarily for rejecting adjacent-channel signals).
2. No gain. Even a small loss would be acceptable. Too much gain could degrade the cross modulation of the intermodulation characteristics of the receiver.
3. No increase in cross modulation, intermodulation, or noise.
4. No instability.
5. High tolerance of impedance match, both for the input and the output circuits.
6. One control; single tuned circuit.
7. Simple construction.
8. Low construction cost.
9. Parts readily available.
10. Capable of operation from a self-contained power supply.

With these requirements in mind, I built a preselector. I wish I could say I designed it and then put it together and had it work perfectly the first time power was applied.

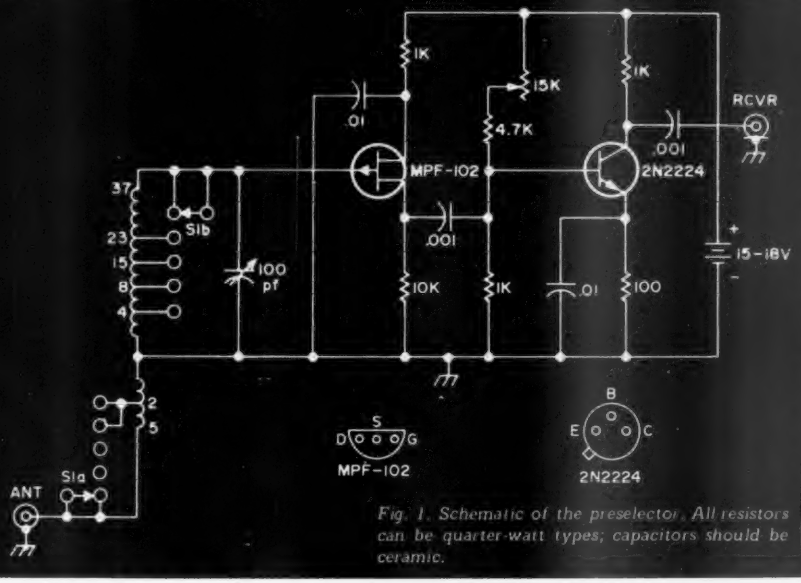

Fig. 1. Schematic of the preselector. All resistors can be quarter-watt types; capacitors should be ceramic.

But the fact is, I learned several new things and unlearned several things I'd previously considered to be factual! But isn't that the essence of amateur radio?

The unit was needed for use over the whole high frequency spectrum; that's why tapped coils are used in both the antenna and the tuned circuits (Fig. 1). High input impedance (for best selectivity) and freedom from cross modulation and intermodulation indicated the use of a field-effect transistor; using a junction FET as a source follower further enhanced these desirable characteristics. Isolation from reactive effects required the use of a low-gain, ultra-stable stage coupling the source follower to the output.

As mine was an experimental unit, I used perf-board and mounted all components on that. You may elect to put it into a cabinet and mount the tuning capacitor and band switch on the panel, a much neater way of doing business.

You can wind your own coil quite easily, using one of the popular plastic pill boxes for a form. I used a piece of Air Dux 832 T coil stock. It's 1 in. diameter and has 32 turns per inch – also, it just happens to be the right size to make a firm pressfit into the top of one of those pill containers, a very convenient way of mounting the coil upright. Five turns up from the bottom, I cut the wire and left a one-turn gap before the start point of the secondary portion. The primary is tapped two turns from the cold end (the end nearest the secondary); this tap is used for the two highest tuning ranges. The secondary is tapped (from the cold end) at 4, 8, 15, and 23 turns; it has a total of 37 turns. Don't take these figures as sacrosanct; stray values of inductance and capacitance can affect them markedly.

The band switch is a two-pole, five-position rotary switch, mounted for short leads to the coil and to the variable capacitor. Note that two of the primary switch points are left unused. Nothing is served by altering the primary turns in small steps.

The tuning capacitor is a two-bearing job, quite sturdy. It measured 100pF fully meshed, and minimum capacitance is 10 – 12 pF.

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Nothing is unusual about the MPF-102 junction FET. There's a 1 kΩ decoupling resistor in the drain circuit to encourage rf to use the 0.001 μF capacitor as a path to ground. Coupling from the source to the NPN bipolar transistor is through a 0.001 μF capacitor.

You may be astonished at the low values of the base-to-ground resistor and the collector load resistor. These were selected to keep gain low and stability high. The gain can be controlled (at the expense of stability) by the 15-kΩ variable resistor in series with the 4.7-kΩ resistor used for applying positive bias to the base. It's best once set and then forgotten. In the emitter circuit, there's a bypassed 100Ω current-stabilizing resistor, something I like to put into the emitter circuit of every bipolar transistor used.

Rf output is taken off the collector through a 0.001 μF blocking capacitor to a short piece of 50Ω coax.

You'll note there's no switching arrangement for disconnecting the preselector. I use RCA-type phono plugs on my receiver, so it was convenient to use a like system on the preselector. It can be detached in a moment . . .and there's no feedthrough problem!

A word about that bipolar resistor. You'll not find the 2N2224 listed in many supply houses, yet it shows up on surplus printed-circuit boards. That's where I got mine. It's good, although several other NPN rf transistors worked quite well, too. So don't get concerned about getting any particular type of transistor. If you can't get an MPF-102 easily, the Motorola HEP-802 is an even swap.

The preselector performs amazingly well. The tuning is sharp, so much so that a slow-motion dial might be a good investment. It's quite astonishing to note just how much of the "crud" that you thought was inherent to a band disappears when the preselector deletes images. I suspect, also, that some of the diminished noise is attributable to a reduction in cross modulation and intermodulation. Anyway, the effect is delightful. You'll be glad you built it!

W5JJ■

Roy E. Gould W5PAG
4748 DeBeers Drive
El Paso TX 79924

The Transistor

12 WATTER FOR 10

Transistors are now available at reasonable prices that can handle a fair amount of power, even at frequencies beyond the 10 meter band. The 2N2631 is one of these and it was used as the final amplifier in the rig described in this article. Input power to the final is about 12W on CW and when driven as a linear for SSB, an input power of about 8W PEP is possible with low distortion.

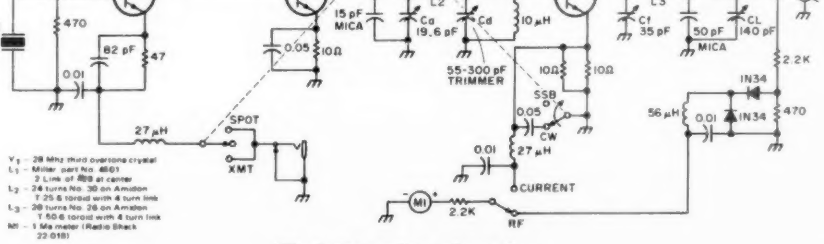
While 12W is not high power, it is more than the average transistorized rig is capable of running and is enough power to do a good job when the 10m band is open. I have worked fourteen Japanese stations on CW while running 12W input and two Japanese, one German, and one Italian station while running 8W PEP input on SSB. Also, I have had many solid QSOs with U.S. stations, mostly on the east coast and in the midwest with this rig. The antenna used was a two-element 10/15 meter quad, up about 15 ft.

The Circuit

The rig consists of three stages: input, driver, and final. The circuit is shown in Fig. 1.

The input stage operates either as a third-overtone crystal oscillator for CW or as a linear amplifier for SSB. The circuit was taken from RCA, who designed it to be the oscillator of a CB rig. The transistor is intended for CB use and the oscillator works well on 10 meters.

When used as an oscillator, a third-overtone crystal is plugged into the crystal


+45V
0.01
10 μH
100 10W
100 10W
0.01
0.01
1K
SSB
12V ZENER 10W
SPOT
30 pF MICA
LINK
120 R1
0.01 C1
CW
XMT
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4.7K
L1
27 μH
40080
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LINK
0.01
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LINK
0.01
L2
L3
Y1
470
15 pF MICA
Ca 19.6 pF
Cd
10 μH
C1 35 pF
50 pF MICA
CL 140 pF
82 pF
47
0.05
10Ω
0.01
55-300 pF TRIMMER
10Ω
10Ω
2.2K
1N34
SSB
1N34
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0.01
0.05
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L3 – 28 turns No. 26 on Amidon T 50 6 toroid with 4 turn link
M1 – 1 Ma meter (Radio Shack 22 018)

Fig. 1. Transmitter schematic.

Front view of the rig.

socket. The emitter circuit is keyed for CW operation. For use as a linear amplifier, the SSB signal is simply plugged into the crystal socket. No changes are required in the circuit itself. Less than 20 mW PEP is required to drive the input stage.

The driver stage uses a 2N4427 transistor, a high-gain VHF unit capable of 1W CW output at 250 MHz. This stage operates class C for CW amplification. The emitter resistor and its bypass capacitor produce the reverse bias needed for class C operation.

When used as a linear amplifier for SSB, forward bias is applied to the stage by switching the input bias resistor to the 12V supply. This allows the amplifier to operate class AB and makes the stage linear. It also reduces the gain of the stage slightly, but is necessary to obtain good linearity.

The driver uses an inductor input pi network as its tank circuit. This network tunes the output from the driver and matches the impedances between the driver and the final. It also provides a means of adjusting the drive to the final.

Both the oscillator and driver operate from a 12V power supply. This voltage is obtained by using a resistor and a 12V zener.

The final is biased for class C CW use by the voltage developed across the emitter resistor and its bypass capacitor. The final current is measured by reading the voltage across the emitter resistor.

When the final stage is used as a linear, the emitter bypass capacitor is disconnected, allowing the emitter resistor to introduce current feedback into the stage. Without this feedback the stage is quite nonlinear; however, with the feedback, it is linear up to a power input of about 8W. Introducing the feedback reduces the gain of the stage slightly but is necessary to obtain usable linearity.

The final uses an inductor input pi network as its tank circuit. This tank circuit can match resistive loads of 30–200Ω to the transistor. It uses a toroidal inductor and link coupling, and operates similarly to the conventional capacitor-input pi network, allowing a variety of loads to be matched.

The meter reads either relative rf voltage output or final current. The rf voltage output indication is used primarily when tuning the rig. If the final current meter is to be used to measure input power, it must be calibrated using another meter in the collector circuit between the power input terminal and the rf choke.

As shown in Fig. 2, the power supply uses two 24V filament transformers with the secondaries connected in series. The secondary voltage is rectified by four diodes in a bridge. The voltage is regulated by the transistor, whose reference voltage is fixed by the zeners. The output is filtered by the 2000 μF capacitor.

The power supply works well and the regulation is good. The no-load output voltage is 47V and the output at 1A is 43.5V. The ripple at this current is 1.4%.

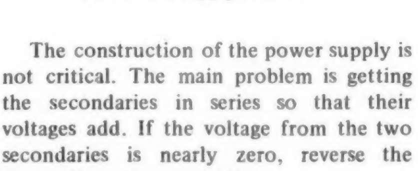


Fig. 2. Power supply schematic.

The construction of the power supply is not critical. The main problem is getting the secondaries in series so that their voltages add. If the voltage from the two secondaries is nearly zero, reverse the connections to one winding.

Construction

The rig, except for the power supply, was built on a 5¾ x 9 in. perf-board. An aluminum base (1½ in. high) was made from sheet aluminum and the perf-board bolted to it. A front panel was made and fastened on with screws. An aluminum partition was used above and below the perf-board, between the final circuit and the rest of the circuitry for a shield. Some of the variable capacitors were mounted on the shield.

A wire was placed along and connected to the aluminum shield and used as the common ground bus. A single ground connection to this bus was used from each of the three sections of the rig. This was done to minimize ground loops.

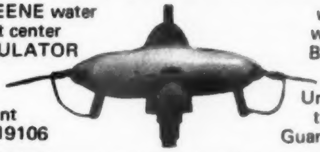
The driver and final transistors were mounted on heatsinks made from sheet aluminum. The driver heatsink is 2¼ in. square with a ½ in. wide mounting flange on the bottom. The final heatsink is 2½ x 3 in. and also has a ½ in. mounting flange on the bottom. The transistors were mounted by passing their leads through three small holes in the heatsink. A piece of aluminum (1 x 1½ in.) and two screws were used to hold the transistor against the heatsink. Heatsink compound (silicone grease) was used to obtain good thermal conductivity.

No electrical insulation is needed between the heatsink and the transistor because the heatsink is bolted to the perf-board, which provides electrical insulation. A three-terminal strip was mounted on the heatsink and the transistor leads connected to it to provide convenient tie points.

The input stage was built close to the front panel to minimize the length of wire between the crystal socket and the base of the input transistor. The circuits were built using perf-board pins and each circuit was kept as compact as possible.

The "linear/class C" switch should be a rotary type and it should be placed as close as possible to the final transistor emitter resistors to minimize wiring inductance, since the gain of the stage is very sensitive to inductance in the emitter circuit.

If the rig is to be used exclusively for CW or as a linear, the switch may be left out and rig wired for only the use intended. If the rig is to be used for CW only, R_1 and C_1 may also be left out and the link connected directly to ground.



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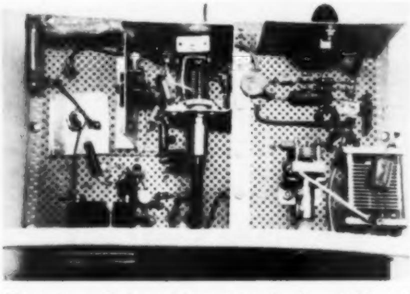
Tuning Up

A 45V supply capable of a current output of at least 500 mA is needed to power the transmitter. After the power supply, dummy load and key are connected, turn on the power supply and place the mode switch in the spot position. Insert a third-overtone 10m crystal and close the key. While monitoring the operation of the oscillator with a receiver, adjust the inductor in the oscillator tank until strong stable oscillation occurs.

Now place the mode switch in the transmit position and momentarily close the key. Notice if there is any indication on the rf output meter. If not, adjust C_a until an indication is obtained on the rf output meter and then tune C_f and C_L to obtain maximum rf output. Then alternately adjust C_a and C_d in the driver tank circuit to obtain maximum rf output. The rig should now be close to the best tuning, but additional tuning of the oscillator inductor and the driver and final tank capacitors may result in more output.

Care should be exercised not to drive the final to an input of over 14W. This was not possible with my particular circuit, but might be possible if your transistors have higher gain than the ones I used.



Top view of the wiring; note the heatsinks and the shield between the final and rest of circuit.

On SSB, drive is connected into the crystal socket. The SSB signal can come from any available source. I used an HW-100 as the source of the SSB signal. The HW-100 was connected to a 50Ω dummy load and the drive signal taken from the dummy load. The method is shown schematically in Fig. 3. Using this setup, a relative rf reading of S-6 on the HW-100 drove the linear to 8W input.

After the initial tuneup, the rig can be tuned for SSB operation on the desired frequency by first applying a low level CW signal to the input and tuning the driver and the final capacitors for maximum rf output from the final. Then apply enough drive to produce 8W input and retune for maximum output.

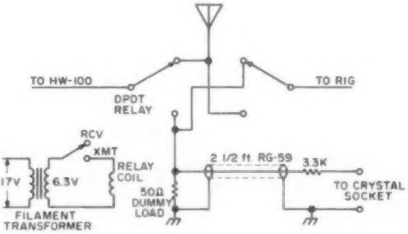


Fig. 3. Method used to obtain SSB drive from the HW-100.

The CW output level from the HW-100 is not the same as the SSB output level at the same setting of the drive control. Therefore, after tuning the linear using CW, it is necessary to adjust the drive on SSB. This is done with the mode switch of the HW-100 in a SSB position by first turning the drive control completely down. Then while whistling into the mike the drive is turned up until full input (8W) to the final is obtained. The rig is then ready to operate on SSB.

Final Comments

This little rig does a surprisingly good job on both CW and SSB. I have had many solid contacts with it and have encountered several operators who found it hard to believe my power was this low. Incidentally, I thought I was doing well to work out with this little rig when I worked a station on CW in Liverpool, N.Y. who was using 182 mW input and 100 mW output. He was not very strong but perfectly readable. Low power is often sufficient on 10m, and this rig can do a good job for you.

. . . W5PAG ■

A SLICE OF NIPPON CULTURE *through RADIO*

If you've packed away your old Hallicrafters or Hammarlund receiver, there's a pretty good incentive now to dig it out. There's a whole lot of fun stuff goin' on.

Main editorial room of Radio Japan.

Editors prepare copy for programs in some of the 23 different languages in which Radio Japan broadcasts.

Swedish-speaking announcer on the air with Radio Japan's Scandinavian service.

Just as millions of Japanese TV viewers nightly delight in watching imported American programs like *Lassie*, *Perry Mason*, *The Beverly Hillbillies*, and *Mission Impossible* (all dubbed in Japanese), more and more Americans are tuning in on the upper end of 20m to learn about Japan, savor the delicate sounds of Japanese music, and struggle with Japanese language lessons.

It's all brought to them by *Radio Japan*, the overseas broadcasting service of NHK, Japan's public radio and TV network. According to the Japan Trade Center, New York, NHK provides the service as a way of promoting friendly relations between Japan and the people of other countries. The initials stand for Nippon Hoso Kyokai, or Japan Broadcasting Corporation.

Far from being limited to Japanese residents abroad, *Radio Japan* broadcasts in 23 different languages and is heard on every continent of the globe. Anyone with a shortwave receiver equipped with four or more bands and a frequency range of up to 21 MHz can tune in.

The *Radio Japan* staff is well sprinkled with editors and announcers from many of the countries the programs are beamed at. With their Japanese coworkers, they pro-

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The news and commentary segments account for more than half of all programming. Features attempt to introduce and interpret Japan from all angles – sociological, economic, and cultural. Music ranges from traditional Japanese and other Asian strains to present-day pops of both Japan and the West.

Proof of *Radio Japan's* growing audience is found in the stacks of mail that NHK receives, the Japan Trade Center relates. About half a million cards and letters from enthusiastic listeners all over the world arrived at the studios in Tokyo last year, the Center says.

Staff workers examine latest collection of picture postcards received from Radio Japan listeners on six continents.

The mail indicates that listeners fall mainly into three categories. There are those who have lived in or visited Japan and like the feeling of nostalgia the programs bring, as well as the chance to keep up with current developments. A second group consists of those who simply have an interest in Japan and find the news and features an indispensable source of information and enjoyment.

The third category is made up of a growing number of people – especially in the United States – who use *Radio Japan* to learn or brush up on the Japanese language. One reason for the great popularity of *Radio Japan's* language instruction programs is thought to be the fact that teachers of Japanese are relatively scarce abroad, while more and more people are becoming interested in Japan and in learning the language.

Two instruction courses are offered weekly. "Let's Learn Japanese" is for beginners, who may later progress to the advanced course, called "Let's Practice Japanese." Free textbooks accompany the courses and are sent to listeners who write in for them.

Programs beamed to New England and the East Coast begin at 6:45 p.m. nightly, at 17.825 or 15.445 MHz. This is one of nine regional services broadcast in local languages for one or two hours a day.

RADIO
JAPAN
club
RADIO JAPA

Souvenir pennants are especially prized by young listeners of Radio Japan. Many join Radio Japan fan club, which has 30 chapters around the world.

In addition, *Radio Japan* broadcasts news and commentary in English and Japanese every hour on the hour worldwide at a number of different frequencies. These transmissions have a duration of either one half or one full hour.

New listeners especially are urged to report the fact that they have heard *Radio Japan* by writing in to NHK. In return, they will receive an official verification card, handsomely styled in the Japanese manner. The address is *Radio Japan* NHK, 2 Uchisaiwai-cho 2-chome, Chiyoda-ku, Tokyo, Japan.

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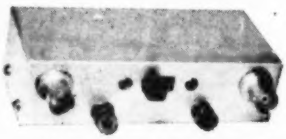

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The RX-10 is a solid-state, four-band receiver of surprising and impressive quality. For those of you who have read the articles that have appeared describing the direct-conversion system* of detection and wondered whether to homebrew and experiment with the circuit, you won't need to. The Ten-Tec RX-10 sports a commendable commercial version of the circuit.

In the direct-conversion or "synchrodyne" receiver, the incoming signal is mixed with a signal from a local oscillator so that the difference of the two frequencies is a frequency in the audio range. Eliminating any i-f stages or conventional detector stage, the signal is then passed through an audio amplifier and the desired selectivity is achieved through audio filters rather than through Q-multipliers, crystal filters, or other radio frequency devices. Because the incoming rf signal is immediately converted to audio, no bfo is necessary for SSB or CW reception.

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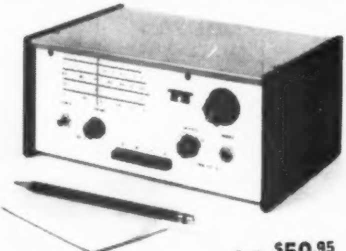

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TEN-TEC RX-10

Aimed at the portable enthusiast and the Novice, the RX-10 is designed for headphone operation and does not include a built-in speaker. This is no disadvantage to the ham working through Novice QRM or the distractions of portable operation. (Whoever heard of a brasspounder not using cans, anyway?)

There is plenty of audio gain with the RX-10, and the sensitivity is astonishing. Tuning is easy, with pushbutton band changing, and the rig has a jack for a key (the RX-10 has a built-in code practice oscillator and CW monitor, too).

While not a DX or contest performance receiver, the RX-10 might seem the answer to the prayers of many a brasspounder who has wanted a truly portable CW receiver. Small, lightweight, solid-state, and needing only cans and a hunk of wire to pull in the signals, the RX-10 can provide plenty of signals to copy.

This little receiver definitely should silence the skeptics who have questioned the practicality of the direct-conversion receiver. Here is an attractively packaged, truly portable receiver which outperforms the simple, regenerative portable designs and definitely challenges the heavier, bulkier, multitube "simple superhets."

You'll probably not work the world with the RX-10, but you will hear enough stations for many pleasant QSOs whether at home or on the road. For those Novices or confirmed old brasspounders who envy those VHF'ers with their hand-held units, the commendable performance-to-weight ratio of the RX-10 may start a flurry of homebrew and commercial activity towards making HF CW more portable (and more popular). All we have to do now is figure out some way to make an efficient 80 meter whip about 19 in. long.

. . .WB2MYU

**See, for example, "Direct Conversion – A Neglected Technique," Hayward and Bingham, QST, Nov. 1968.*

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GETTING FOR

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DX Editor Dave Mann recently said he could "cite example after example" of hams who have aided in various emergencies. "Yet the newspaper coverage in these situations has been minimal or nonexistent altogether," Dave notes.

As a newspaperman for some 12 years, I can attest to Dave's observations. But the blame should not be placed on the newspapers. With the exception of releases from MARS, there has yet to be one story formally submitted to The St. Louis Globe–Democrat by a radio amateur during the past 12 years, save for those personally written by this reporter!

There is no trick to getting publicity for your amateur radio activities. I can assure you, editors welcome news that is different from the day-to-day carnage and gloom they print. There are some common-sense rules in getting publicity. To publicize routine activities you should:

ONE – Submit a written release. Don't call the newspaper and try to tell the editor the story over the phone.

TWO – Submit the release well in advance.

THREE – Have all the details in the release, including where the sender might easily be reached.

FOUR – Try to have the story "break" at a time most convenient to the newspaper. Space is at a premium. However, a newspaper usually has more room in its Sunday or weekend edition.

FIVE – A *very* local story might be discarded by the metropolitan paper, but be much in demand by the editor of a neighborhood newspaper, so don't forget to send him a carbon.

SIX – And as long as you're making carbons, send copies also to radio and television stations. Media editors "log" such releases and you might be surprised to

PUBLICITY HAM RADIO

see sound-on-film crews show up at your next hamfest!

SEVEN – Remember that the average reader does not understand technical and abbreviated terms such as RTTY, CW, SSB, etc. Keep it simple, yet interesting and informative. For example: "Single Sideband – the type of radio telephone communications used by astronauts as well as amateur radio operators – will be the topic of discussion at the Podunk Amateur Radio Club Meeting Tuesday, June 30."

Note the reader now has probably been introduced to the term "single sideband" for the first time. He paid attention because he could relate the term to something he is somewhat familiar with, astronauts and moonshots. As a result, his (and the editor's) attention was gained. The story was printed and read.

EIGHT – If a release is printed, drop a line to the editor thanking him for his help. If there is a feature on ham radio printed, again write and tell the editor how much you enjoyed it.

NINE – If you have an unusual feature and a reporter is assigned to the story, don't think you're doing him a favor by giving the story to him. He gets paid by the hour – not the byline.

TEN – All the above applies to *routine* stories and releases. However, should a disaster occur and your radio club become involved in emergency communications, call the newspaper and radio and TV stations immediately. Again, if you call a day or two later, it's "yesterday's news."

There have been many times that amateur radio was the only source of information to the public. That information cannot be disseminated, however, if the newspapers, radio, and TV don't hear of it.

. . . K0YTI ■

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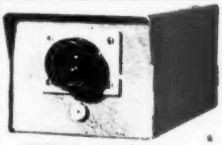

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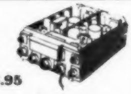

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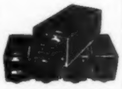

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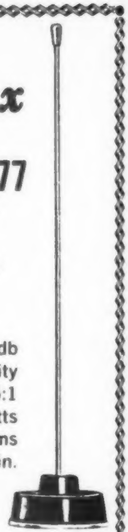

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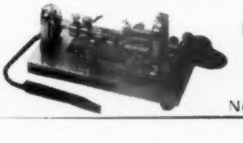

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4	5	⑥	⑦	⑧	9	10
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⑱	⑲	⑳	㉑	㉒	㉓	㉔
㉕	26	㉗	㉘	29	30	

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GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7A	7	7	7	7	7	14	14	14A	14
ARGENTINA	21	14	14	14	7	7	14A	21A	21	21	21	21
AUSTRALIA	21	14	7A	7B	7B	7B	14B	14	14	14	21	21
CANAL ZONE	14	14	7A	7A	7	7	14	21	21	21A	21A	21
ENGLAND	7	7	7	7	7	7B	14A	21	21	21	21	14
HAWAII	21	14	7A	7	7	7	7	7B	14	21	21	21
INDIA	7	7	7B	7B	7B	7B	14	14	14	14	14	7B
JAPAN	14	14	7B	7B	7B	7	7	7	7B	7B	7B	14A
MEXICO	21	14	7	7	7	7	7A	14	21	21	21	21
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SOUTH AFRICA	14	14	7	7B	7B	14	21	21	21	21A	21	21
U. S. S. R.	7	7	7	7	7	7B	14	21	21	21	21A	7B
WEST COAST	21	14	7A	7	7	7	7	14	21	21	21	21

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ALASKA	21	14	14	7	7	7	7	7	14	14	21	21
ARGENTINA	21	14	14	14	7A	7	14	21	21	21	21	21
AUSTRALIA	21A	21	14	7A	7A	7B	7B	14	14	14	21	21
CANAL ZONE	21	14	14	14	7	7	14	21	21	21	21A	21A
ENGLAND	7B	7	7	7	7	7	7	7B	14	14A	21	14
HAWAII	21A	21	14	7A	7	7	7	7	14	21	21	21A
INDIA	7B	14	7B	7B	7B	7B	7B	7B	14	14	14	7B
JAPAN	21	14	14	7B	7B	7	7	7	7	7B	14	21
MEXICO	21	14	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	14	14	7B	7B	7B	7B	7	14	14	7B	14A
PUERTO RICO	21	14	7A	7	7	7	14	21	21	21	21	21
SOUTH AFRICA	14	14	7	7B	7B	7B	14	21	21	21	21	21
U. S. S. R.	7	7	7	7	7	7B	7B	14	14	14	14	7B

WESTERN UNITED STATES TO:

ALASKA	21	21	14	7	7	7	7	7	7A	14	21	21
ARGENTINA	21	21	14	14	14	7A	7	14	21	21	21	21
AUSTRALIA	21A	21A	21A	14	14	14	7	7	14	14	21	21A
CANAL ZONE	21	21	14	14	7	7	7	14A	21	21	21A	21A
ENGLAND	7B	7	7	7	7	7	7B	7B	14	14A	14	14
HAWAII	21A	21A	21	14	14	14	7	7	14	21	21	21A
INDIA	14	14	14	7B	7B	7B	7B	7B	14	14	14	14B
JAPAN	21	21	21	14	7B	7	7	7	7	7B	14	21
MEXICO	21	21	14	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	21	21	14	7B	7B	7B	7	14	14	7B	14A
PUERTO RICO	21	14	14	7A	7	7	7	14	21	21	21	21
SOUTH AFRICA	14	14	7	7B	7B	7B	7B	14	21	21	21	21
U. S. S. R.	7B	7B	7B	7	7	7B	7B	7B	14	14	7B	7B
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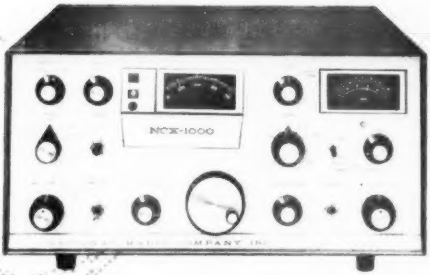

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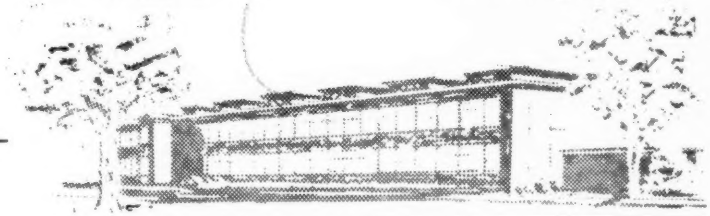

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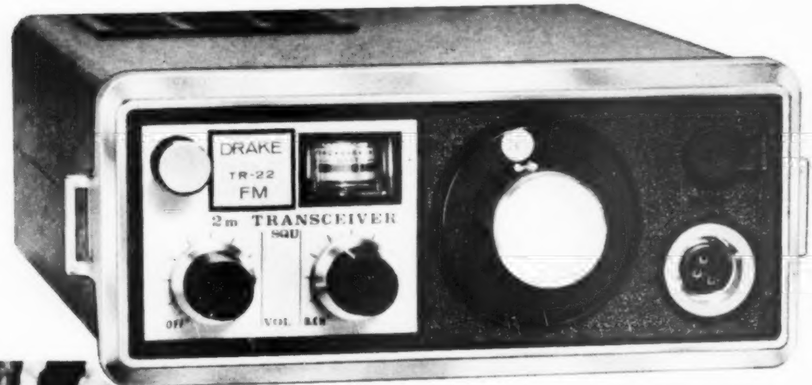

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GENERAL • **Frequency Coverage:** 144-148 MHz • **6 channels, 3 supplied:** **(1)** Rcv: 146.94 MHz, Xmit: 146.34 MHz; **(2)** Simplex: 146.94 MHz; **(3)** Rcv: 146.76 MHz, Xmit: 146.34 MHz • **Frequency modulation** • **Push-to-talk** Xmtr Control • **DC Power Drain:** Rcv: 45 mA, Xmit: 450 mA • **Power Source:** 12 VDC ± 20%; 120 VAC 50-60 Hz (for recharging nickel cadmium batteries only.) • **Size:** $5\frac{3}{8}$" x $2\frac{5}{16}$" x $7\frac{1}{8}$", **Wt:** $3\frac{3}{4}$ lbs.

RECEIVER • **Completely transistorized** crystal controlled double conversion superheterodyne circuit. • **1st IF** 10.7 MHz • **2nd IF** 455 KHz • **Antenna Input Impedance:** 50 ohms • **Sensitivity:** 1 microvolt or less for 20 dB S+N/N ratio • **Audio Output:** 0.7 watt at 10% or less distortion • **Built-in speaker.**

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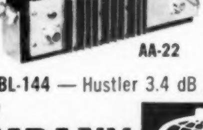

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